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The Crystal — A Thing of Beauty and a Tool of Science

ALLAN T. GWATHMEY

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Crystals have long fascinated the intellectually curious, the artistically conscious, and the economically ambitious. They have fascinated the intellectually curious, for the human mind craves order and an understanding of the possible ways of obtaining order; and a crystal, such as a diamond, represents one of the most highly ordered systems in nature. The atoms of carbon are regularly arranged in a three-dimensional lattice. Because of this order which makes it possible for crystals to form facets that sparkle, they have been the object of admiration among those concerned with personal adornment and decoration. Glistening crystals in the form of jewelry have long been a symbol of aristocracy, wealth, and good taste. Because of this regular arrangement, too, crystals have special properties which make them economically important. This economic importance is increasing rapidly, and large industries will soon be based on the production and sale of man-made crystals. Examples are crystals of silicon used in harnessing the energy of the sun, crystals of germanium used in transitors which may replace vacuum tubes in electronics, and low-priced synthetic star sapphires which in beauty surpass the costly natural products.

THE DEVELOPMENT OF THE SCIENCE OF CRYSTALLOGRAPHY

The history of crystallography is an interesting one. It had long been observed that crystals possessed definite faces which made constant angles with each other. This fact was formally stated in 1669 in a law known as the Law of Constancy of Angles. There lived in France in the 18th Century a biologist named Hauy, an abbe in the Catholic Church, who was especially interested in the shapes and colors of flowers. He did not have to wander very far from this fascinating subject of flowers to inquire about the shapes and forms of crystals. He noticed that a large crystal of calcite could be broken or cleaved into smaller crystals having the same shape as the large one, and he naturally wondered about the nature of the inside of a crystal which could produce this effect. When he referred the faces to a regular set of coordinate axes, he noticed that the intercepts of the different faces on these axes could not have any value, but were so related that the crystal must have a regular inner structure.

EDITOR'S NOTE: It is with pleasure that we present this invited article by Mr. Allan T. Gwathmey.

The important characteristic of a crystal is that it has a regular inner structure as compared to a piece of glass with no such structure. Thus Hauy found in crystals definite evidence for the existence of atoms arranged in a three dimensional pattern before Dalton advanced his atomic theory in the early part of the 19th Century. It should be remembered that the conception of atoms was an ancient one, but that it was not until Dalton put forward experimental evidence for the existence of such atoms in the field of chemistry that the atomic theory was accepted. Because of this observation concerning the relationships of the intercepts of the various faces, commonly known as the Law of Rational Indices, Hauy, a biologist, is known as the father of crystallography.

Before further progress could be made, it was necessary for crystals to be classified according to their external shapes, and this was done by many workers in many parts of the world. As more and more crystals were examined, it became increasingly obvious that they could best be classified according to the symmetry of their external form. It may seem as if this symmetry is a trivial property, but it is one of fundamental importance. Symmetry is concerned with the relationships between the various parts of an object. More specifically, it is concerned with the operations which must be performed on one part of an object to relate it to another. For example my right arm is symmetrically placed on my body with respect to my left arm, and a vertical plane of symmetry may be passed through my body midway between my two arms. A square has an axis of four-fold symmetry, because the square may be rotated four times, each time by ninety degrees, and the shape will be reproduced four times in making one complete revolution of 360°. Thus one face may be related to another by means of a plane of symmetry, or by means of an axis of symmetry. In respect to the classification of all crystals it was found that they could be grouped into seven systems according to the axes of symmetry which they possessed. It was then found that these seven systems could be further divided into 32 classes by considering not only the axes of symmetry, but also by considering planes of symmetry. These classifications were concerned with the external forms of crystals.

A great turning point in the history of crystallography took place in about 1850 when another Frenchman, Bravais, an astronomer and mathematical physicist, concentrated on the question of the inner structure of the many types of crystals. With mathematical insight he approached the subject from the question of how many ways could points be arranged in space according to definite patterns which repeated themselves in three dimensions. He finally concluded that there were only fourteen different ways or types of patterns by which points could be regularly arranged in three dimensional space, and these were known as the famous Fourteen Bravais Space Lattices. He was next confronted with the important question of explaining how there could be 32 different classes of crystals if there were only 14 different patterns for arranging points in space, and, although he didn't live long enough to see the job completed, Bravais realized that by substituting for his points in space a unit of pattern, that

could be a group of several atoms which itself had symmetry, this process would enable each of the seven space lattices to include several classes. The existence of the 32 classes was thereby explained. Even with this brilliant insight into the possible arrangement of atoms in space, the job of explaining the inner nature of crystals was not yet completed, and other workers realized that there could be other elements of symmetry besides planes and axes. Thus two new elements of symmetry, glide planes and screw axes, the nature of which need not be described at this point, were added. Then by substituting for the points in each of the 14 space lattices, units which had in turn the symmetry of the 32 classes, and taking into consideration the possible existence of glide planes and screw axis, the remarkable conclusion was reached that there were 230 space groups, and only 230 such groups or patterns, by which atoms could be arranged regularly in 3 dimensional patterns. There are an infinite number of crystals if the atoms are put closer or farther apart, but the types of patterns or designs by which these atoms can be arranged are limited to only 230. This profound conclusion was reached by several people in different parts of the world almost at the same time, and when X-rays were discovered by Roentgen in 1895 it became possible to check this conclusion. Since X-rays have the power of penetrating into solids, they are reflected by the many planes of atoms which exist within. From these reflections it is possible to determine the arrangement which these atoms have assumed in three dimensional space. With the aid of X-ray diffraction 230 space groups were confirmed.

During the last 30 years, this new science of X-ray diffraction has revolutionized our understanding and use of metals. Prior to X-ray diffraction nothing was known about the structure of metals, and they were produced by methods which were largely guess work. With X-ray diffraction it is now possible to tell how the atoms are arranged in their crystal structure, and how these structures change when impurities are added or when the material is heated or strained. In fact our whole knowledge of solids has been revolutionized by this X-ray technique. All solids, except a few materials such as glasses, have some degree of crystal structure. A cotton fiber, a fingernail, or a hair has a certain degree of crystallinity, and the properties of such materials as textiles depend greatly on their semi-crystalline nature.

Since the atoms in a crystal are arranged according to a regular pattern, it would be expected that these crystals themselves would have special uses as a tool of science. For example, they are used as prisms or lenses to give radiant energy of particular wave lengths which in turn are used to study structure and the nature of the chemical bonds between atoms. Large crystals are also used for the study of many physical properties such as the strength of materials and electrical conductivity. Large crystals of metal, one half to one inch in diameter, have been used extensively at the University of Virginia to study the surface properties of metals, and a few examples of these studies will be described.

THE STUDY OF THE SURFACE PROPERTIES OF METALS WITH THE AID OF LARGE SINGLE CRYSTALS

It is not without meaning that the present period in history is referred to as the Age of Metals. Metals are so commonplace in industrial society that their importance is not always appreciated. Automobiles, airplanes, electrical machinery, and atomic power depend far more than is generally imagined on the use of metals. The development of the steam engine was held back until new metals could be developed, and today in the development of jet engines and atomic power the limiting factor is metals which can withstand high temperatures and radiation. Thus it is important to understand the basic properties of metals, especially their surface properties, since the chemical attack of a metal must begin at the surface.

If one looks at an ordinary piece of iron or copper under the microscope it can be seen that the surface is composed of many little crystals randomly arranged somewhat like grains of sand on a beach. If an attempt is made to measure a particular property of such a surface, for example, to determine the amount of oxygen which reacts with the metal, one would measure a composite quantity consisting of the oxygen which had reacted with all of the different faces, edges, and corners of all of the different grains. Since oxygen reacts differently with each type of structure, this composite measurement would tell very little about the activity of any one type of structure. In the case of a metal, if its properties are to be understood, it is necessary to isolate one particular face at a time and to study its fundamental properties on a quantitative basis.

In order to accomplish this, the method developed at the University of Virginia consists of growing metal crystals which are so large that the individual faces may be identified and the rates of reaction on each face may be measured. The method is analagous to studying the properties of each of the faces on a large diamond in order to understand the properties of diamond dust. Ordinary metals in their polycrystalline form are similar to the diamond dust. In this method of study the large crystal becomes an instrument, or "a tool of science", which can be used to accomplish two different but closely related purposes. First, to return to crystallography, this large crystal can be used to study those basic and often obscure relationships between symmetry, regularity of pattern, and irregularity or imperfection of pattern. Through such studies, it is possible to make contributions to the science of crystallography, which, as we have seen, is one of the crowning accomplishments of the human mind. The science of order and beauty yields to none in elegance and importance. Second, through the study of the properties of these large metal crystals, it is possible to contribute to the technology of metals which are used in so many important ways in modern industry. The basic properties of the unit metal crystal is an "industrial gold mine" of tomorrow, for in some of these undiscovered properties lay hidden revolutionary new uses of metals. In spite of the great use of metals today our knowledge of their basic properties is shockingly small.

In this method, large metal crystals are grown by very slow cooling of molten metal in a vacuum furnace. They are grown in the form of a rod, one half to one inch in diameter, from which either spheres exposing all possible faces, or slices exposing primarily one particular face may be machined. The strained layer from the machining is removed and a smooth surface is obtained by mechanical polishing followed by electrolytic polishing. This latter type of polishing consists of electrolytic etching by which metal in the protrusions is removed more rapidly than that in the valleys so that a smooth surface of the base metal is exposed. The specimen is generally heated in hydrogen at 500° C. in order to remove further strains and reduce any oxide which may have formed on the surface. It is then ready to be used for the study of surface reactions. It should be clearly understood that the arrangement of atoms varies with the crystal face exposed at the surface. If a sphere is cut out of crystal rod, in the case of the cubic system every face will be exposed in at least six places on the sphere. This can be visualized by considering a sphere to be

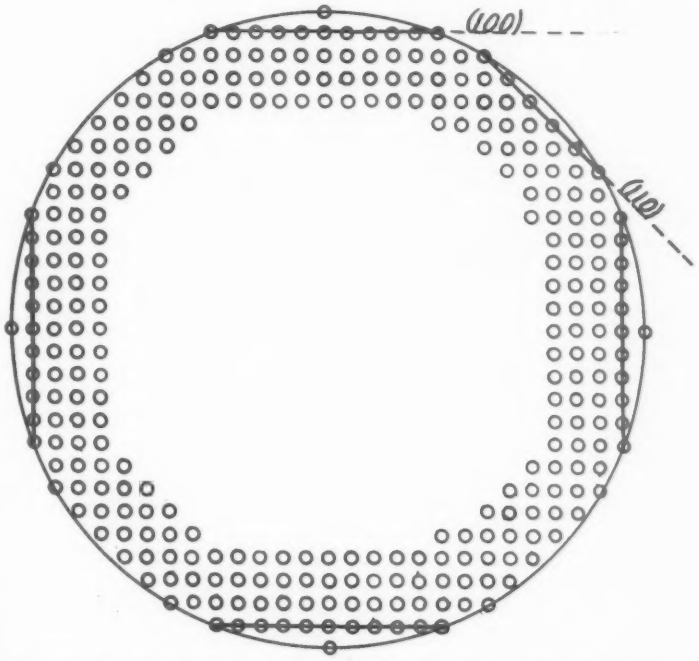

FIGURE 1.—Diagram in two dimensions illustrating the different spacings between atoms on several faces of a crystal in the form of a sphere.

placed within a cube so that the sphere is tangent to each of the six sides of the cube. The appearance of different faces with their different spacings of atoms at the surface is illustrated in two dimensions in Figure 1. Theoretically each face would appear on the surfaces of the sphere at a single point, but if the sphere is sufficiently large there will be a great many atoms in each crystal face which will be approximately on the surface of the sphere. Therefore in effect all the major faces appear on the surface of the sphere, and from the symmetry of the patterns which form on the surface during reaction, as explained below, the different crystal faces may be easily identified.

Several different types of "Reaction Patterns" will form on the spheres during reaction. In cases where the reaction products actually build up on the surface, as in the oxidation of copper, the oxide film will form more rapidly on one face than on another. If the sphere is examined with the aid of white light when the films are in the range of 300-2000 A thick, the different thicknesses of oxide on the different faces will show up as a regular pattern of interference colors of incomparable beauty. In cases where the reaction products do not build up on the surface, but pass on as in the catalytic reaction of hydrogen and oxygen to form water on the surface of a copper crystal, small facets form over the surface because of either gas etching or rearrangement of the surface atoms. If such a crystal is examined in the dark room with the aid of a flash light, a brilliant pattern of reflections can be seen over the surface of the sphere, and again from the symmetry of the pattern of reflections the various crystal regions can be identified. Etching by liquids also produces such facets and gives similar reflection-patterns.

Methods have been developed whereby measurements may be carried out on a single face and the effects of edges and other faces may be eliminated. It should be emphasized that this method of study is in principle a very simple and logical one, and through its use it has been shown that the chemical activities of any one metal will vary markedly with the face exposed at the surface. For example, it was formerly assumed that all the faces of a crystal of copper had the same chemical activity, and now it is known, as a result of these studies, that each type of face exposed at the surface behaves as if it were a separate metal. In other words, there are as many types of copper as there are types of faces exposed at the surface. Examples from two important fields of chemistry, oxidation and catalysis, will illustrate the striking effect which crystal face has on the chemical activities of metal surfaces.

Oxidation is probably the most important of all reactions and is basic to an understanding of processes taking place in the presence of air. The invisible thin oxide films which form on metals are even of controlling importance in such processes as wetting, and friction and wear. There are several methods of measuring the thickness of oxide films, but the most convenient is that of interference colors which may be used as a measure of the thickness of the films in the range of 300-2000 A. As stated

previously, the different thicknesses of oxide on the different faces show up as a regular pattern of interference colors. In Figure 2 is shown an oxidation pattern of a spherical crystal of copper which was heated in oxygen at 250° C. for about fifteen minutes by K. R. Lawless of the University of Virginia. The (100) face which is located in the small square

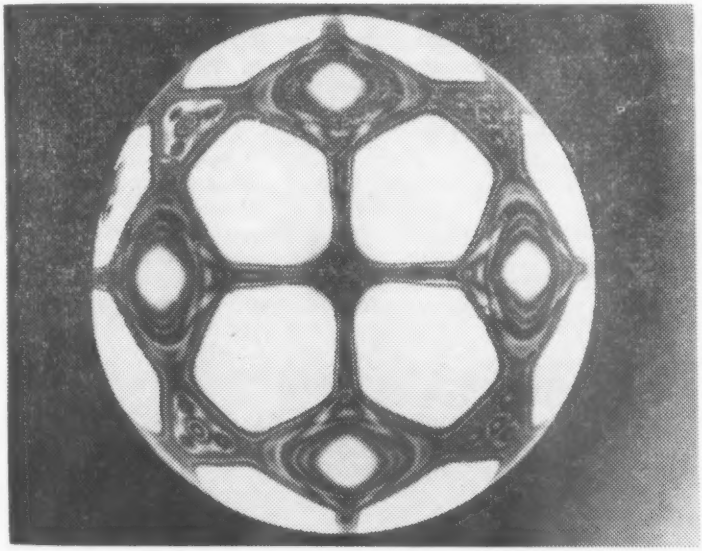

FIGURE 2.—Photograph of a single crystal of copper which had been heated in oxygen at 250° C. for 15 minutes.

at the center of the cross had an oxide film on it at least ten times thicker than that on the (311) face which had the lowest rate and is located approximately at the center of the large five-sided light regions. Thus the rate of oxidation of copper varies greatly with the crystal face exposed at the surface.

In the field of catalysis one of the great unsolved problems has been the determination of the positions of high and low activity on the surface of the catalyst. The single crystal method offers a very effective way of studying the nature and activity of a catalyst surface. With the aid of this method it was shown in such catalytic processes as the reaction of hydrogen and oxygen on a crystal of copper that the surface rearranges to form definite facets which are characteristic of the particular reaction. Both the rearrangement and the rate of the reaction vary with the face exposed at the surface.

Other fields of surface chemistry such as electrodeposition, etching, wet-

ting by liquids, cohesion, and friction and wear have been studied with the aid of large metal crystals, and in every case the properties have been found to vary markedly with the crystal face exposed at the surface.

IMPERFECTIONS IN CRYSTALS

So far it has been emphasized that crystals consist of atoms regularly arranged according to definite patterns, and it has been implied that the structures of the crystals are perfect or nearly perfect. Actually many types of imperfections have been found to exist in crystals, and some of the most interesting properties of crystals have been shown to be due to these imperfections. In spite of their increasing importance these imperfections are difficult to see. Figure 3 shows evidence for a type of imperfection called a spiral dislocation. F. W. Young of the University of Virginia heated a polished copper crystal in a high vacuum to a sufficiently high temperature, approximately 1050° C., to evaporate metal from the crystal. When the (111) face of the crystal was examined under the microscope, the spiral shown in Figure 3 was seen. Imperfections or dislocations are regions of high energy, and evaporation tends to take place more easily at the region where the dislocation meets the surface.

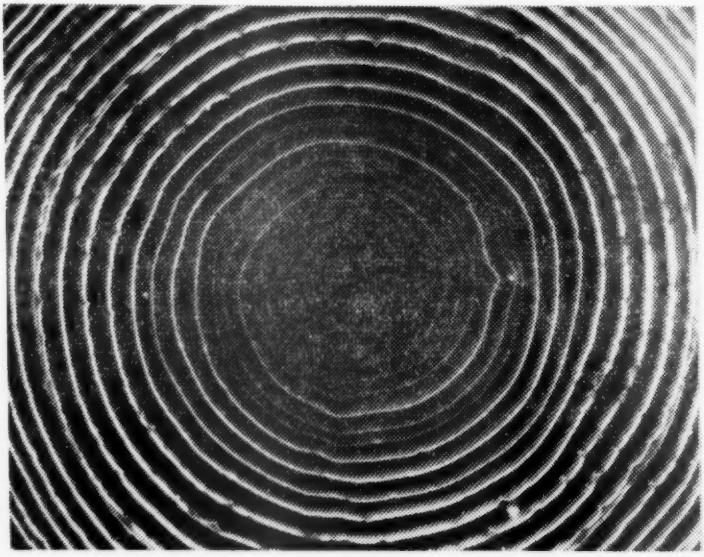

FIGURE 3.—Photograph of a single crystal of copper from which copper had been evaporated by heating in a vacuum at 1050° C. Note spiral formed.

Both the chemical and physical properties of metals and other solids have been found to be dependent to an amazing degree on imperfections of various types. A new division of science, referred to as the Chemistry and Physics of the Solid State, has developed within the last fifteen years which is especially concerned with an understanding of the influence of these imperfections on the properties of solids. The strength of iron can be increased a hundred fold if certain imperfections are removed or reduced. The electrical properties, especially conductivity, of certain crystals are dependent on defects or imperfections which can be produced by adding small amounts of impurities, and such effects are utilized by the electrical industry in making transistors which in many cases are replacing vacuum tubes in the field of electronics.

Because of our knowledge of crystals accumulated over many years it is literally possible today to make crystals which can talk, hear, remember, amplify, and convert sunlight into electrical energy. It is difficult to tell which is the most interesting aspect of a crystal, its beauty, its order, or its strange properties which make it useful. All aspects of a crystal, no matter how obvious or spectacular, however, are dependent on the less obvious arrangement of atoms in patterns of various degrees of perfection.

The studies at the University of Virginia were supported by the Office of Naval Research.

The Logical Basis of Evolution [1]

RICHARD E. BLACKWELDER
Secretary, Society of Systematic Zoology

Evolution has been the subject of discussion and lecture for a long time. It has been involved in many controversies and will doubtless be involved in still others. Few subjects have such broad implications or so many points of contact with intellectual life. So it is not surprising that a college course on evolution should be given to persons with widely different sources of interest in the subject.

But whatever one's reason for studying evolution, I hope none will finish the course without realizing that he has been studying the grandest and most complicated conceptual scheme in all of human knowledge. Simply for this reason alone, the subject of evolution is worth the study of every educated person.

A conceptual scheme is a logical picture that successfully brings together and explains a large number of otherwise confusing and apparently diverse phenomena. The scheme should be relatively simple and must not need to be revised every time a new fact is discovered. Such a scheme will be fruitful, in that it will lead to the discovery of new facts and new relationships.

In conceptual schemes, however, we enter into the part of knowledge where sound thinking is absolutely essential. Bertrand Russell once remarked that "Most people would sooner die than think — in fact they do so." Such people should stay away from conceptual schemes and particularly from the one about the evolution of matter and life.

The interesting thing about conceptual schemes is that they don't require objective proof of all their constituents. We take some facts (as many as we can get), some theories as to the meaning of the facts, some deductions of the logical implications of these theories, and we weave them all together in a web of interrelations in which each node is supported by certain facts and certain theories, in such a way that any one conclusion is almost certain to be true unless most of the others are false.

We must not overlook the fact, though, that a conceptual scheme can be erected, on erroneous data and false assumptions, that will look reasonable enough but be in fact completely erroneous. In dealing with any conceptual scheme it is important to recognize what is fact and what is hypothesis.

Now the reason why I call evolution the grandest conceptual scheme of all is that it includes most of the others. When we speak of evolution in general we include the evolution of living things, the evolution of complex chemical processes, the evolution of the earth, the evolution of the universe, and the evolution of matter and energy.

[1] A lecture given at the University of Virginia on October 31, 1955.

EDITOR'S NOTE: We take this opportunity to thank Mr. Blackwelder for permitting us to publish this thought-provoking lecture.

There is little doubt that *organic* evolution is part of the general scheme. In fact one of the most basic laws of science, the second law of thermodynamics, makes it practically impossible for there to be any part of the material universe in which there is not change in the form of increasing complexity. This is evolution in the cosmic sense. We can be pretty sure that change is a fundamental characteristic of all matter.

I called evolution the most complicated conceptual scheme in our experience. Here I was thinking particularly of organic evolution, and I meant complicated in the sense of having to express the relationship of facts of inconceivable complexity and number.

Perhaps you have already had a glimpse of the amazing complexity of life, which we seldom think about in our daily existence. The vast range in which life exists —— more than a million different kinds now living and very likely a hundred times this many that lived in the past. The tremendous complexity of the human body with its quantity of cells so great that we have no adequate words for it. For example, it is said that in human blood the red corpuscles are so numerous that, in order to replace the worn out ones in your body, you must produce 80,000,000 new ones every second. In development a human egg two-tenths of an inch in diameter, weighing perhaps three millionths of a gram, develops through cell multiplication into an individual that weighs about one billion times as much.

All these facts, and their history, their interactions, their causes, their meaning, are involved in the conceptual scheme of evolution.

When we think of the physical and chemical level of life organization even these figures seem small.

All life consists largely of proteins, and proteins consist of amino acids, of which there are less than 40 kinds known.

The amino acids combine into polypeptides, which consist of two or more acids, the largest yet known having eighteen components. These combine into chains to form the proteins, which have molecular weights of 10,000 or more, some as high as 5,000,000, as compared with 18 for water and 342 for cane sugar.

Even these figures do not do justice to the complexity and potentiality of the protein molecule. It has been estimated that in a *relatively simple* case of a protein with 50 amino acids, of 19 different kinds, the number of possible arrangements of these 50 parts will be 10^{48}, or 10 followed by 47 zeros.

To get an idea of how large this figure is, let us see where we can find a number of comparable size. We know that our Milky Way galaxy is pretty large. It is so large that light takes 300,000 years to travel the length of it, going at the speed of 186,000 miles per second. This is a distance of more than 10^{16} miles.

But the mile is a pretty big unit of measurement. There are 150,000 centimeters in each mile. The smallest unit of measurement is the Angstrom Unit, of which there are 100,000,000 in each centimeter. If we multiply these out, we get the diameter of the universe, expressed in these almost

infinitesimally small units, as barely more than 10^{30} Angstroms. This makes the 10^{48} possible combinations of a "simple" protein look pretty large. Of course, we do not know that all of these possibilities are feasible thermodynamically or biologically.

Our conceptual scheme must take all this into account, not only its complexity but the history of how it got to be so complex.

So we should have no trouble seeing the importance of this particular conceptual scheme.

One of the things we must keep in mind in thinking about evolution (or any other conceptual scheme) is logic, the processes of reasoning we use. Logic is a tricky subject for beginners. We can easily be fooled in using it unless we know what we're doing. Here's a simple example:

Dogs are reptiles.
Reptiles are cold-blooded.
$\therefore$ Dogs are cold-blooded.

This is a correct logical argument. The conclusion is true *if* the premises are true.

We know that the conclusion is *not* true, and we see that one of the premises is not true. We must be careful, though, about saying that one is the result of the other. If we change it thus:

Dogs are reptiles.
Reptiles are *warm*-blooded.
$\therefore$ Dogs are *warm*-blooded.

we still have a logical argument, and we know that the conclusion is true. But there are still errors in the premises. And this is a very simple form of logic and of fallacy.

In drawing conclusions from facts we must not only be sure of the logic, but also sure of the facts themselves, and sure that we have taken into account all the facts.

Now let's have a look at what evolution is supposed to be.

If you look at the books on evolution and those on the general principles of biology you will find many statements about the evidence upon which the principle of evolution is established. You will also find declarations that evolution is proved.

For example, one of the most recent textbooks on evolution says, "It is no longer a theory but an adequately demonstrated process." Other books say that "The truth of evolution was proved conclusively . . ." or "Ample proof has been repeatedly presented." There are many variations of this theme.

If you are thinking as you read these books, you will probably notice that these authors almost always fail to tell you what they mean by this word evolution, —— what is included in this thing they say is proved. Is the meaning so obvious that we can assume that all men will have the same ideas about what it implies?

This is something that we can investigate, because there are some published statements of what evolution involves, and there are many things implied by writers who do not fully define the concept. As a matter of fact there are very few concise statements of what evolution is, and these are not by the writers who make the claims that it has been proved.

Here are some of the things claimed by modern authors as part of the concept of evolution:

(1) The organic world has not always been as we see it now; there has been change.

(2) All living things are related to each other, more or less distantly.

(3) Life on earth has developed gradually, from simple to complex.

(4) The organisms now living are descended from different organisms which lived in the past.

(5) All the changes have resulted from processes that are still in operation today.

(6) The changes are the result of mutations and the action of natural selection on survival.

(7) Life originated only once, and therefore life now comes only from pre-existing life.

(8) The ancestors of all present-day organisms trace back through an unbroken chain to the first living organism.

(9) Change is progressive, always producing more advanced forms.

(10) Forms never change back into pre-existing forms.

(11) No major group has ever become extinct.

(12) The history of the race can be traced in the development of the individual. (This is the much discussed biogenetic law, that ontogeny recapitulates phylogeny.)

Many variations of these and other things have been included in evolution. If we say that evolution is proved or that "I believe in evolution," do we mean *all* these things? If not, then which ones?

It is one of the tragedies of modern science that this all-important concept has not been pinned down so that it can be logically studied and discussed. I will call your attention to some of the faults in the claims listed and then see if we can pick out the real facts behind them.

We may fairly accept the fact that life has not always been as we see it now. We do not accept it on the basis of fact, or because it has been proved to be so, but because it is reasonable to accept it on the basis of another conceptual scheme, that of stratigraphy. We can watch a dead animal or shell being buried in the mud or sand of a lake, see successive layers of the soil being washed in on top of it. We know that the top layers came later in time. When we find a similar sort of animal imbedded in layers of soil, we feel sure it got there the same way. When the soil is replaced by rock, we still believe the processes are adequate, for we can sometimes see soils being cemented together. We therefore believe

that the fossils we find in rocks are the remains of organisms that existed at the time the layers of rock-material were deposited. Most of these fossils are at least slightly different from any kinds of organisms living today, so we can scarcely fail to accept the postulate that life was different in the past.

There are many pieces of evidence that lead us to think that one animal is related to another. We know of blood relationship between persons of our own family, and we know very definitely also of the relationship between two generations. We have no doubt that the relationship goes back five generations, or ten, or a hundred. Then why not also a million? We have little reason to doubt the kinship of all those individuals we place in any one species. But how much farther back can we go?

Do we have any evidence that a dog and a jellyfish and a redwood tree are related in any useful sense of the word? It would take us at least several lectures to discuss the various things that have been suggested as evidence, but if we did so we would find that there is not one shred of *factual* evidence. There is enough suggestive evidence to make it reasonable for us to think there is a relationship, but there is also plenty to make us wonder about it.

The most cogent reason for doubting is this. If we follow back each of the major lines of development of animals (and these are what we call the phyla), we find that only the vertebrates arose in the midst of the time we can study by means of fossils. All the other phyla were present, distinct, and well-developed at the time when the fossil record begins. We may assume that these groups evolved, diverged, and became distinct in the time before the fossil record began, but it is just as well justified to believe that they never were related. You can take your choice, but you can't disprove the other fellow's idea, unless you dig up evidence not known heretofore.

In all the billion years of life recorded in the rocks, there have always been very simple organisms, very complex ones, and all the stages in between, all living together in very complex manner. Can we be sure that these all came from one single kind that arose through a single accident and then produced all the variety of life now known? We do love the neat simple explanations like this, but life is not simple, and it is unlikely that its origin and evolution were simple.

In a very general way the fossil record supports the idea that life has developed gradually from simple to complex, at least within the great groups of similar animals. The fishes of the Paleozoic are not as highly organized and complex as those living today. So with many other groups. But there are exceptions, many of them. By almost any standard we apply, the physical nature of obligatory parasites is much simpler than the non-parasitic groups to which they seem to be akin. Such parasitism has arisen many times separately in different groups. We call it degeneration. It is very hard to justify calling it progressive evolution. Again, if a real reversal of evolution did occur, how could we detect it?

Here we may take some comfort from the fact that that basic law of

physics mentioned before, the Second Law of Thermodynamics, requires that all spontaneous reactions shall produce greater complexity. When two simple elements, sodium and chlorine for example, combine, they produce sodium chloride, which is more complex than either of the elements. There seems to be no doubt that this law applies to all matter, whether in living systems or not, and it very probably ensures that in general there will always be increase in complexity. Even in the parasites that can't live alone, the protein structure and enzyme systems may be as complex as in the non-parasitic relatives.

The idea that the processes that operated in evolution and other natural activities in the past are the same as those we see operating today is the Law of Uniformitarianism. This is not the same kind of law as the Second Law of Thermodynamics, for we never get a chance to test this one in any experiment. All we can say is that we have seen no proof that it doesn't hold. Likewise, however, we must admit that we see no *direct* evidence that it *does* hold in the *far* past.

When we look back a million years in imagination, we have little trouble believing that the earth was much the same as now. There surely were mountains and rivers and sun and oceans and seasons. But what if we look back *five thousand million* years? The earth may have been newly formed; it may have been closer to the sun; it may not have had tides; it may have had different seasons; it may have had quite a different proportion of chemical elements at the surface. From the point of view of life, can we be sure that these things and their interactions were all the same as they are now?

Again, we think of life in terms of our own experience. But what do we know of the kind of life that first appeared? There is a tremendous gap between the simplest known life and the most complex non-living matter. Does the same sort of evolution apply at the molecular level, the asexual cellular level, the sexual multicellular level, and the level of intelligent life? We know that *some* factors are different; and we may be on shaky ground to believe that there has been no change in evolutionary processes —— no evolution of evolution.

It has been stated that no major group of animals has ever become extinct. Obviously by "major group" was meant something larger than the order of dinosaurs or the class of trilobites, for we know they are extinct. We may assume that *phyla* were intended. But how can we make such a statement? No matter what group I name, you can say, "Oh, but that belongs in the Coelenterata (or the Mollusca). It is not a distinct phylum."

Take the graptolites, for instance, those curious little colonial and usually branching forms, made of chitin, and usually floating suspended from the surface of the ocean (or so we imagine). No one denies that they existed (as shown by numerous clear fossils) and that they are now extinct. They were for many years placed in the Coelenterata, but most recent classifiers have transferred them clear up to the Hemichordata, where they

are tentatively put as a subphylum. Can we reasonably say that they are not an extinct major group?

One of the paleontologists in the National Museum recently showed me a shell of unknown affinities. It is conical, so it has been put in the Mollusca near the snails, but the specialist in each group says it doesn't belong with his pets. The catch is that it incorporates a feature never seen in any living animal or in any other fossil. Instead of having a single conical body cavity in the conical shell, it has two semiconical cavities. No one knows what nature of animal built this shell and lived in it, but whatever it was, it is long since extinct. Can we safely say that it doesn't represent an extinct phylum?

To deal adequately with the supposed recapitulation of the stages in the phylogeny of animals by the stages in their individual ontogenies would take at least a whole lecture. Yet this is often cited as one of the important evidences of evolution.

This is one of the most misused, misunderstood, and misquoted concepts in all of biology. Let us briefly look at what facts are agreed upon and what may be reasonably assumed from these facts.

All of the higher organisms pass through a series of stages in development from the egg to the mature individual. These stages are usually not clearly distinct but grade into one another. Most of the stages appear to be necessary to the development of the organism, either structurally or functionally. In different kinds of animals the series of stages are often quite different. In animals which we believe to be closely related, they are most similar.

In some cases one of the stages of one form may resemble very closely a stage in some other form which is thought to represent a remote ancestor. In some cases one of the stages may resemble in a general way the adult of a supposed remote ancestor.

Now if we are to compare these ontogenetic stages with some other set of stages, we must have that other set to compare with. If we are going to compare the ontogeny of some animal, its own personal life history, with the phylogeny of that kind of animal, the history of the development of that kind, we *must* know both the life history and the race history. What kind of animal shall we select, where both of these are known? Here is the big difficulty. We simply don't ***know*** the phylogeny of *any* kind of animal.

Oh, we have some guesses. They are like our guesses about how closely related animals are, only they're even less well founded.

One of the well-known general writers on embryology has fallen into this error. He wrote, "The value of embryology from the point of view of evolution lies in the fact that embryonic forms are like the embryonic forms of related animals." May we interrupt to ask how he knows they are related? Did he watch their evolution, or find direct evidence of it somewhere?

He continues, "As a rule, the younger the embryos are, and the closer akin the species to which they belong, the more closely do the embryos

resemble one another." Here again, how does he judge closeness of kinship? As a matter of fact, practically all very young embryos resemble each other quite closely.

He continues, "The more closely allied the species are, the longer does the resemblance between the embryos persist." The same comment applies here. All that is really involved is that kinds *which we classify* in one group *do in fact* show greater similarity in embryos than kinds which we classify into widely separated groups. This merely reflects the fact that our classifications are based on resemblances — usually of the adults, but which are shown to be correlated with resemblances in the early stages as well and in any case were the result of the same processes as formed the embryonic characters.

Once again he continues, "Embryology furnishes valuable evidence therefore as to affinities, but it cannot profess to give definite information concerning the *adult* forms of ancestors." We can agree with this last, especially if he means the recent ancestors, but is there any evidence that embryology furnishes data as to affinities? We must answer this with a qualified affirmative. *If* we believe that similarity of structure is evidence of affinity in adults, we probably must also accept it as evidence of affinity in the embryo. But it is still highly subjective, because we have not proved that the correlation is real; we merely believe it to be true.

This same writer does not believe that ontogeny recapitulates phylogeny. He believes that it *may* recapitulate the *ontogeny* of the ancestor. But he points out many ways in which the similarity may be upset, even claiming that sometimes the adult descendant may resemble most closely the ancestral embryo, instead of the descendant embryo resembling the ancestral adult. But the assumption that we know the phylogeny of any animal back to the early stage required by this sort of speculation, is a basic fault in these arguments, as in nearly all discussions of recapitulation.

Now, evolution is not a modern concept. It is about a hundred years old in its current form. But the mechanisms that are now believed to be the basis of evolution are of more recent discovery. The current view that the materials of evolution are spontaneous mutations in the hereditary factors, and that these factors are particulate genes that are located in cell bodies called chromosomes, is another conceptual scheme. It is built up of facts about the variation of organisms and logical speculation about its cause and its results. But again the scheme is not a fact, — only a logical system that seems to be adequate to explain the known phenomena.

What, then, are the basic facts about living matter which have given rise to the explanatory conceptual scheme which we call evolution? They seem to be only five at the first level, and very simple and direct ones.

First, life is displayed only in discrete entities that we call individuals. It is not a continuous film of matter or a single mass, but a multitude of separate masses usually connected to each other only for short periods of time. Second, there is diversity among the individuals. They are not all alike but represent many forms, structures, activities, and materials. Third, there is discontinuity in the diversity. Life does not form a continuous

series of forms from simple to complex but is divided into discrete groups or kinds which are not continuous with other groups. Fourth, there is inheritance of likeness within the kinds. Each individual is the product of one or two other individuals and receives from them the factors which will make it like them. Fifth, there is change. Living forms are not fixed and unchangeable but are subject to constant small discrete changes which make the offspring just a little different from their parents.

These are all general truths that we can see and demonstrate. Their explanation lies in the nature of matter, for the first three apply equally to inanimate matter. So far, there is no evolution.

Now we leave the realm of pure fact and add increasing amounts of speculation. Our conceptual scheme of stratigraphy and fossils seems to justify us in believing that the diversity we see today is different from the diversity we would have seen a million years ago. It also seems to justify us in believing that the successive stages of diversity have increased in complexity as time passed, with the most complex stage of all the one we see around us.

These two assumptions or beliefs require explanation, for stratigraphy merely suggests what happened and not why it happened, or how.

The only explanation that fits our ideas of scientific rigor is that the increasing diversity of life is the result of progressive change, increasing complexity. This is evolution; this is the concept that I have described as of such fundamental importance. The observed diversity of life, its material, structure, form, and activity, exhibiting discontinuity into individuals and kinds, is the result of progressive change acting through heredity.

Even this fundamental statement we cannot call proved. It has two unproved assumptions. But we can say that it is a reasonable scheme, one fruitful of further explanations, and the only one which gives adequate explanation of all known facts without raising other unanswered problems. On this basis it must logically be accepted by every person who fails to produce an acceptable scheme of some other sort.

Evolution, then, proclaims that the facts of individuality, diversity, discontinuity, heredity, and change can be compounded with the assumptions that different sets of diversity existed in the past and that they became successively more complex up to the present time, to form a coherent explanation of this sequence of change and the variety of life both present and past.

I must emphasize that this concept of evolution does *not* include many of the things that have sometimes been included in it. It does not tell us whether life arose from inorganic matter once or more than once. It does not tell us whether there were false starts, that fizzled out. It does not tell us whether all forms of life arose from one primordial form or whether there were several quite different lines developed from as many separate ancestors which emerged from non-living matter independently.

It does not tell us why some lines have expanded and changed rapidly, why some have remained unchanged for hundreds of millions of years, or

why some have become extinct. It does not tell us whether the processes involved in evolution today are the only ones that have been involved since the beginning, or whether they are themselves unmodified during that long time. It does not tell us that any particular organism is descended from any particular other organism.

It does not tell us the nature of the processes which were involved in the heredity of the organisms, or the processes which gave rise to the changes or their perpetuation. Nor does it tell us whether there were forces controlling the direction of change, except as these are inherent in the matter involved.

It does not tell us the phylogeny of any organisms, or even whether we may hope to know this someday. It does not tell us the meaning of the resemblances between developmental stages and possible ancestral stages.

If we can keep all these extraneous things aside, we will have no difficulty in making a reasonable case for the truth of evolution as an explanatory scheme. As Dobzhansky has so aptly put it, "Evolution as a historical process is established as thoroughly and completely as science can establish facts of the past witnessed by no human eyes. At present, an informed and reasonable person can hardly doubt the validity of the evolution theory, in the sense that evolution has occurred."

REFERENCES

DEBEER, G. R. 1928. Vertebrate Zoology. London.

DOBZHANSKY, TH. 1951. Genetics and the Origin of Species. New York.

JEPSEN, G. L., *et al.* 1949. Genetics, Paleontology and Evolution. Princeton.

LINDSEY, A. W. 1952. Principles of Organic Evolution. St. Louis.

SIMPSON, A. G. 1949. The Meaning of Evolution. New Haven.

WOODGER, J. H. 1929. Biological Principles. London.

An Electric Field Meter

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INTRODUCTION

Waddel *et al.* investigated in 1946 the causes and effects of radio static created by aircraft flying through disturbed weather, and Wagner *et al.* in 1947 dealt with corona losses on high voltage transmission lines. In such investigations dealing with electrical charges the investigators must know, within an accuracy of a few percent, the magnitude and polarity of the electric field about the bodies in question.

The earth itself is charged with respect to the upper atmosphere. McDonald (1953) states that when we walk outside on even a fair day, our heads are in air that is some 200 volts positive with respect to the ground at our feet. Under a thundercloud our heads might be in air that is 20,000 volts above ground potential.

Even though it is a poor conductor, air does conduct a measurable current between the upper atmosphere and earth. The air-to-earth current depends upon the conductivity of the atmosphere and the electric field caused by the charges in the upper atmosphere. While measuring air-to-earth current, workers at General Electric Company (Heinmiller and Staff, 1953) were able to detect the jet stream in which intercontinental bombers, guided missiles, and everyday commercial airplanes can hitchhike with great savings of fuel. Continuous recordings of the earth's electric field taken at weather stations along with the other usual data would prove very useful to weather forecasters and the military forces.

THE PROBLEM

During the course of specialized research in weather at the University of Virginia Engineering Experiment Station, the need for an electric field meter that would meet the following design specifications has become apparent.

1. The instrument must indicate the polarity of the electric field.
2. The instrument must be insensitive to 60 cycle electric and/or magnetic fields to insure proper operation even in the presence of high voltage 60 cycle power lines and 60 cycle machinery.
3. It must be capable of measuring the voltage gradients expected to be encountered, from 30 to 10,000 volts per meter.
4. The instrument must be stable and remain calibrated for maximum reliability with minimum calibration even with wide line voltage variations and tube characteristic changes.

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5. It must be suitable for use either as an instrument indicating the instantaneous electric field or a recording instrument providing a plot of electric field variations against time.
6. The parts exposed to the electric field must be small to insure minimum distortion of the electric field by the presence of the instrument.
7. The parts exposed to the electric field must not be adversely affected in any way by exposure to any weather conditions because the instrument might be used outdoors.
8. The number of rotating parts must be kept to a minimum because rotating mechanical parts are cumbersome (especially high speed switches using brushes and commutators).

Previous electric field instruments described in the literature were of two general classes:

Those in the first class (Koenigsfeld and Piraux, 1950; Gish and Sherman, 1937; Mauchly, 1926; and Wilson, 1905) used a wire or probe well insulated from ground and exposed to the electric field. An electrometer measured the potential which the wire or probe assumed in the field. These instruments were undesirable because:

1. The insulation resistance had to be maintained at values greater than a million megohms (10^{12} ohms), making the insulators highly susceptible to contamination by water and dust.
2. The long wires and large probes were not readily portable.
3. The electrometers used were delicate, drifted, and were not readily adaptable to be used as recording instruments.
4. The response time was too long to register transients.

The instruments in the second class, which were discussed by Gunn (1954), Tremaine and Cheek (1950), Waddel (1948), Workman and Holzer (1939), and Kirkpatrick and Mayake (1932), were the "generating" type; that is, a conductor was alternately exposed to and shielded from an electric field, thus generating an alternating voltage which was proportional to the electric field. This voltage was amplified and applied to an indicating or recording meter.

An instrument of this type developed by Tremaine and Cheek (1950) was a composite of the previous generating voltmeters and met all of the required specifications except:

1. The parts exposed to the electric field were large and bulky.
2. The sensing part was exposed to direct contact with raindrops which can carry charges (Gunn, 1947). These drops could possibly cause erratic readings by charging the sensing element or by shorting the insulators holding the sensing element.
3. The instrument used a mechanical rotating switch.

Gunn in 1954 discussed a generating field meter which met the specifica-

tions except that his instrument had no provision for the elimination of 60 cycle fields.

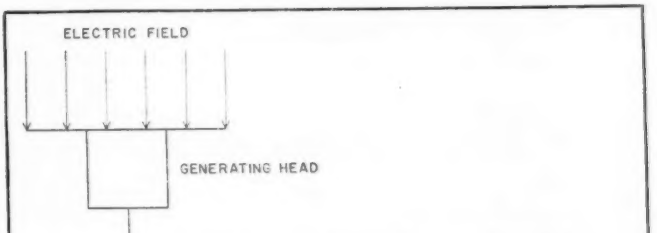

FIGURE I

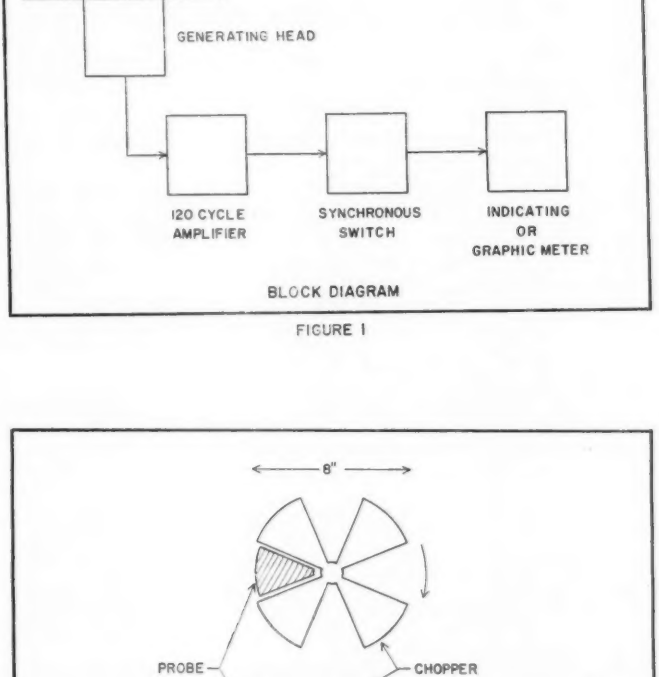

FIGURE II

Because these generating field meters meet most of the design specifications required, it was decided to modify the instruments of Tremaine and Cheek and Gunn to include all of the specifications.

THE INSTRUMENT

The block diagram of this instrument is shown in Figure I. In the generating head, the only part exposed to the field, is the chopper, shown in Figure II, which alternately exposes the probe to the field and shields it, thus generating an alternating voltage on the probe. The chopper rotates at the synchronous speed of 1800 R.P.M., being turned by a small synchronous motor (Bodine NSY-12), giving a 120 cycle probe voltage. Any 60 cycle electric field obviously is cancelled at the probe. The probe is connected to the grid of a battery-operated cathode follower, the low impedance output of which is fed through a cable to the step attenuator and thence to the 120 cycle amplifier as shown in Figure III. This amplifier (after Scott, 1938) is tuned to 120 cycles to further eliminate any possible 60 cycle error voltage. Negative feedback is used in the amplifier to stabilize the gain and linearity as set forth by Terman and his co-workers in 1939.

Following the 120 cycle amplifier there is a synchronous switch which is no more than a differential amplifier gated by a 120 cycle square wave. The square wave is derived from the 60 cycle line voltage, and is always in phase with the probe voltage. The chopper is adjusted mechanically on the motor shaft so that the synchronous switch will be gated "on" when the probe is exposed and "off" when the probe is shielded. The output of the synchronous switch then is a pulsating direct voltage, the average of which is directly proportional to the magnitude and polarity of the electric field. This direct voltage can either be applied to an indicating voltmeter calibrated to read in volts per meter from center scale or filtered and applied through a suitable direct current amplifier to the pen motor of a paper chart recorder.

CALIBRATION.—The calibration of this instrument was relatively simple. A one-quarter inch mesh hardware cloth screen, 15 feet square, was supported on a wooden frame two meters above the ground. With the generating head placed on the ground under the center of the screen, known voltages were applied between the insulated screen and ground, giving known electric fields. It was assumed that this calibrating field is, for all practical purposes, as uniform as the earth's field. A small calibrating plate was built into the cover of the generating head box and calibrated against the large screen used as a standard. This small calibrating plate is used to check the calibration. One merely closes the cover over the chopper and probe and applies known voltages to the plate.

In bad weather the generating head box is operated on its side to keep the chopper and probe dry. This decreases the sensitivity to one-sixth, as determined experimentally, which is still adequate to read a minimum field of 30 volts per meter.

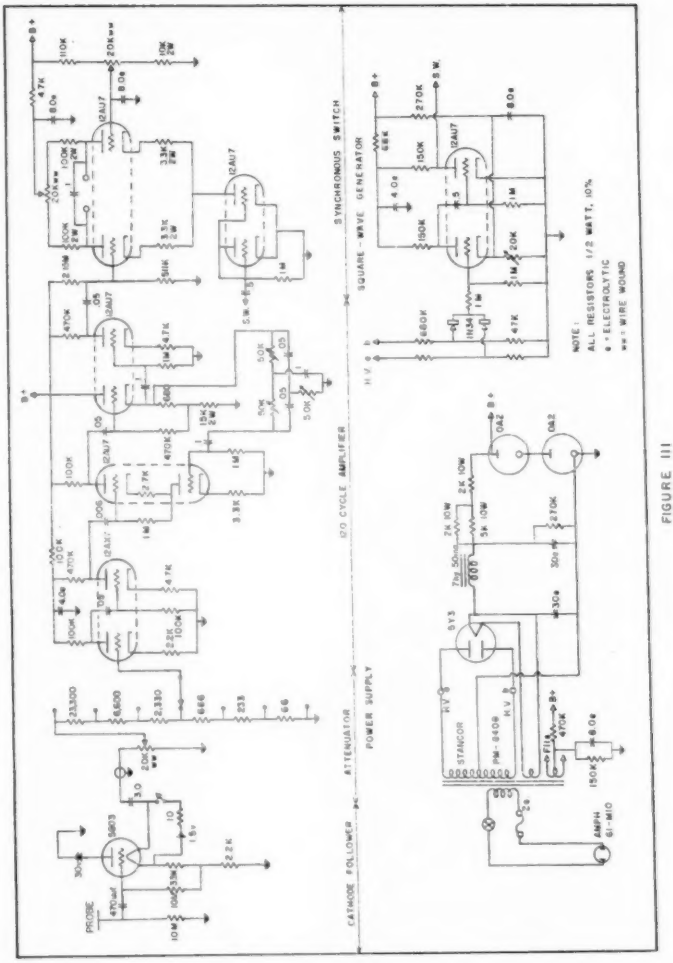

FIGURE III

PERFORMANCE.—It can be said that this instrument meets all of the design specifications:

1. It indicates the polarity of the field.
2. 60 cycle fields have no effect on the instrument.
3. The range is adequate.

4. No appreciable drift in calibration has been observed.
5. With a suitable recorder (such as a Brush Electronics Company BL-202 Oscillograph driven by a simple D.C. amplifier similar to

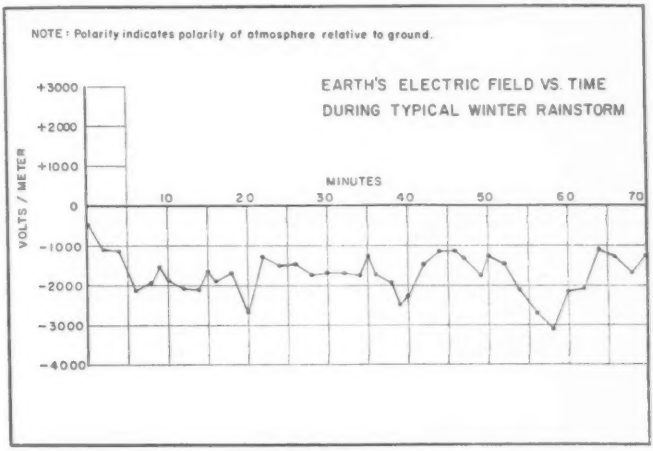

FIGURE IV

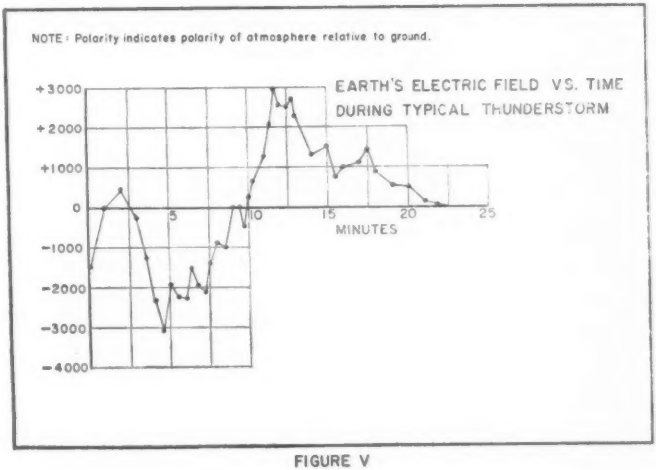

FIGURE V

the Brush BL-905), the electric field can be recorded as a function of time.

6. The generating head is reasonably small and can be made smaller in future designs.
7. Weather conditions do not affect the operation; the instrument has operated successfully during rains at rates exceeding two inches per hour, and once during a snow storm when over a foot of snow fell.
8. The chopper and its motor are trouble free, requiring no particular maintenance.

CONCLUSIONS

Even though this instrument was not designed specifically for general weather research or for weather forecasting, it could be used in this connection. With a few modifications to give automatic features, the instrument could be run continuously 24 hours a day, seven days a week, giving a graph of electric field variations versus time. These variations could be correlated with jet stream observations and other weather data obtained from standard weather instruments.

Figures IV and V show graphs plotted from recordings made during disturbed weather. The polarity indicates the polarity of the atmosphere relative to the ground. It is interesting to note the variations in the field caused by clouds at different potentials drifting by, as is shown in Figure IV. The bottoms of the clouds are negative as set forth by Frenkel in 1947.

Figure V shows data taken under a raining thunder cloud. The field varied as parts of the cloud changed potential with lightning discharges and as the wind carried the cloud over the instrument.

ACKNOWLEDGMENT

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LITERATURE CITED

FRENKEL, J. 1947. Atmospheric Electricity and Lightning. *Journal of the Franklin Institute*, 243(4): 287-307.

GISH, O. H. AND K. L. SHERMAN. 1937. A Leak-free Method of Measuring Air-potentials. *Terrestrial Magnetism*, 42: 285-288. And 1929. 34: 231-237.

GUNN, ROSS. 1954. Electric Field Meters. *Rev. Sci. Inst.*, 25(5): 432-437.

. . . . . 1947. The Electrical Charge on Precipitation at Various Altitudes and Its Relation to Thunderstorms. *Phys. Rev.*, 71(3): 181-186.

HEINMILLER, PAUL R. (Managing Editor) and Staff. 1953. The Jet was Chasing its Tail. Review Staff Report, *General Electric Rev.*, 56(4): 42.

KIRKPATRICK, P. AND I. MAYAKE. 1932. A Generating Voltmeter for the Measurement of High Potentials. *Rev. of Sci. Inst.*, 3(1): 1-8.

KOENIGSFELD, L. AND P. PIRAUX. 1950. Un nouvel electrometre portatif pour la mesure des charges electrostatiques par systeme electronique: Son application a la radiosonde. *Mem. roy. meteorol. Inst. Belgique*, No. 45.

MAUCHLY, S. J. 1926. Control of Ionium Collectors used in Potential-Gradient Registrations at the Observatory of the Department of Terrestrial Magnetism. *Carnegie Inst. Wash. Year Book*, 25: 227.

MCDONALD, JAMES E. 1953. The Earth's Electricity. *Sci. Amer.*, 188 (4): 33.

SCOTT, H. H. 1938. A New Type of Selective Circuit and Some Applications. *Proc. I.R.E.*, 26(2): 226-235.

TERMAN, FREDERIC E., R. R. BUSS, W. R. HEWLETT, AND F. C. CAHILL. 1939. Some Applications of Negative Feedback with Particular Reference to Laboratory Equipment. *Proc. I.R.E.*, 27(10): 649-655.

TREMAINE, R. L. AND R. C. CHEEK. 1950. A Voltage Gradient Meter. *AIEE Trans.*, 69(part 1): 633-637.

WADDEL, R. C. 1948. An Electric Field Meter for Use on Airplanes. *Rev. of Sci. Inst.*, 19(1): 31-35.

WADDEL, R. C., R. C. DRUTOWSKI, AND W. N. BLATT. 1946. Aircraft Instrumentation for Precipitation——Static Research, Part II. *Proc. I. R. E. & Waves and Electrons*, 34(4): 161-166.

WAGNER, C. F., A. WAGNER, E. L. PETERSON, AND I. W. GROSS. 1947. Corona Considerations of High-Voltage Lines and Design Features of Tidd 500 Kv. Lines. *A.I.E.E. Trans.*, 66; 1583-90.

WILSON, C. T. R. 1905. On a Portable Gold-Leaf Electrometer for Low or High Potentials and Its Applications to the Measurements in Atmospheric Electricity. *Proc. Phil. Soc.* Cambridge, 13: 184-189.

WORKMAN, E. J. AND R. E. HOLZER. 1939. A Recording Generating Voltmeter for the Study of Atmospheric Electricity. *Rev. of Sci. Inst.*, 10(5): 160-163.

An Annotated List of the Amphibians and Reptiles of Giles County, Virginia

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This report is based upon observations and collections made during the summers of 1954 and 1955, occasional visits during other months of the year, specimens contained in the demonstration collection at the Mountain Lake Biological Station, and specimens listed in the collections of several museums.

Giles County lies in the Appalachian Valley and Ridge Province in southwestern Virginia and covers an area of 369 square miles. It is bordered on the west by Mercer and Monroe counties, West Virginia; on the east, by Craig and Montgomery counties; and on the south, by Pulaski and Bland counties. It is drained by two different river systems: the northeast by John's Creek, tributary to the James River; and the remainder of the county by New River, tributary to the Kanawha. The area ranges in elevation from 1470 feet near Glenlyn to 4368 feet on Bald Knob. There are eight peaks over 4000 feet in elevation, but many of the valleys have gently rolling terrain. There is an old rolling peneplain 200 to 400 feet above the present level of the New River. Several distinct vegetational types are to be found. Most of the lower terrain has been cleared for pastures and fields. The slopes of the mountains are covered by mixed deciduous forest, and some of the peaks, such as Bald Knob and the Mountain Lake drainage, have small stands of virgin coniferous forest of spruce and hemlock. This varied terrain offers several different habitats for collecting amphibians and reptiles.

All localities mentioned are taken from United States Geological Survey Topographical Maps, Pulaski Quadrangle (1934), Narrows Quadrangle (1913-32), and Pearisburg Quadrangle (1921-32).

There are undoubtedly more species to be found in the county than those listed below and extensive collecting throughout the county should yield several additional ones. The following forms perhaps also occur in the area and should be looked for: *Amyda ferox spinifera, Clemmys muhlenbergi, Opheodrys vernalis vernalis, Lampropeltis calligaster rhombomaculata, Lampropeltis getulus getulus, Elaphe guttata guttata, Heterodon platyrhinos, Haldea valeriae, Storeria dekayi, Eumeces anthracinus, Pseudacris brachyphona, Necturus maculosus, Ambystoma maculatum, Plethodon jacksoni, Plethodon wehrlei, Plethodon richmondi,* and *Aneides aeneus.*

ACCOUNT OF SPECIES

Cryptobranchus alleganiensis alleganiensis (Daudin).—The hellbender is common in the New River and its tributaries and it is often caught by fishermen, who know it as the "water-dog" or "alligator". Specimens ex-

amined were collected in the New River at Ripplemead, in Wolf Creek near the junction with New River, and in Spruce Run at Spruce Run School.

Ambystoma jeffersonianum (Green).——Giles County is the southern limit of the range of this salamander, as shown by Bishop (1947). The two adult specimens seen came from the Mountain Lake area and represent the present known southern-most record for the species. One was collected at Little Meadows beneath a wet log at an elevation of approximately 3500 feet on August 5, 1954, and the other was found beneath a concrete slab in the basement of the laboratory building of the Mountain Lake Biological Station. Larvae, presumably of this species, were found in a small oxbow pond at Little Meadows on August 5, 1954. Ten larvae averaged 17 mm. in size, with extremes of 15.5 and 17.8 mm.

Diemictylus viridescens viridescens Rafinesque.——Common in ponds and slow-moving streams in the valleys, it is particularly abundant in Mountain Lake. Several of the red terrestrial stages have been collected in the moist forest on Salt Pond Mountain.

Desmognathus fuscus fuscus (Rafinesque).——This is the most common salamander in and along streams throughout the county. Females with egg clusters were found on August 2, 1955 (12 eggs) and on August 17, 1955 (18 eggs). Locality records for the dusky salamander include specimens from Big Stony Creek, Little Stony Creek, and John's Creek throughout their length.

Desmognathus ochrophaeus carolinensis Dunn.——This species has been taken from a wet bank beside a spring at Ripplemead, elevation 1600 feet. It has not been found at the higher elevations. Specimens in the American Museum of Natural History (AMNH 54459) from Salt Pond Mountain labeled as this species were examined by Richard G. Zweifel and found to be *Desmognathus fuscus*. Giles County is near the region of intergradation of *D. o. ochrophaeus* and *D. o. carolinensis*, but all specimens examined were clearly of the latter race.

Desmognathus monticola Dunn.——The seal salamander is found in most of the streams of the county. It is very common at the Cascades of Little Stony Creek, where the salamanders can be seen on rock ledges from a few inches to several feet above the water. On being approached, they plunge into the water. With the head protruding they often hide in crevices along streams.

Desmognathus quadramaculatus (Holbrook).——The black-bellied salamander is found in most streams of the county, except those of the John's Creek Drainage, although it has been found 500 feet away in streams tributary to the New River (Carroll, 1950). It is particularly common in the higher streams, such as Little Stony Creek and the small spring-fed streams tributary to it. This is the northern limit for the present known range of this salamander in Virginia.

Plethodon cinereus cinereus (Green).——The red-backed phase of this species is found throughout the county in both wet and relatively dry areas. The black phase is found at Castle Rock, the only locality in the

county the author has collected it. Bogert (1952) referred to these black individuals as "*huldae*" and gave the relative numbers of the two color phases of this species and *P. glutinosus*. In two hours on August 2, 1954, four members of the class in vertebrate zoology from the Biological Station collected 8 *P. glutinosus* (17.4%), 32 red-backed *P. cinereus* (69.6%), and 6 black *P. cinereus* (13.0%). These figures are similar to those given by Bogert (1952).

Plethodon glutinosus glutinosus (Green).——The common slimy salamander is widespread in the area. Several specimens from Clover Hollow Mountain and Newport have very few or no dorsal white spots, though lateral spots are present. Pope (1949) made a statistical study in the Mountain Lake area of several aspects of the biology of this species.

Plethodon jacksoni Newman.——This species has not been found by the author in the county. Newman (1954) states, "There are some specimens reportedly collected from caves in Giles and Craig Counties". The author has collected in 38 caves in Giles County and 6 caves in Craig County and has not found this species as described by Newman.

Hemidactylium scutatum (Schlegel).——This species is reportedly rare in the area. Several class reports in the Biological Station Library mention the occurrence of the four-toed salamander in the area about Salt Pond and Doe Mountain. The author has seen one specimen taken in a sphagnum bog at White Pine Lodge on August 9, 1954. This individual was found by turning over large mats of moss at the edges of the bog.

Gyrinophilus porphyriticus porphyriticus (Green).——The purple salamander has been collected during the summer months beneath wet logs in damp woods on Salt Pond Mountain and in the immediate vicinity of the Biological Station. It is easily collected during rain at night along roadbanks on the Salt Sulphur Turnpike, an unpaved road that traverses Salt Pond, Big, and Fork Mountains. Many adults have been found with their heads protruding from holes in the clay banks at night, while the larvae are common in springs and seeps.

Pseudotriton ruber ruber (Latreille).——The red salamander is common, especially in the higher, clear, spring-fed streams. This species has been taken at the Biological Station, in a small stream at Maybrook, in Starnes Cave near Pearisburg, and in Sugar Run at Bane.

Eurycea bislineata bislineata (Green).——This species is common in aquatic and wet situations throughout the area. It is occasionally found beneath logs in moist woods some distance from water. The larvae of this salamander made up 74% of a collection of 234 salamanders from Link's Spring at Maybrook, collected from June 20-22, 1955. This salamander has been found in nearly every stream from which collections were made.

Eurycea longicauda longicauda (Green).——The long-tailed salamander has been taken at the following places in the county: C. C. Starnes Cave, 2.5 miles southwest of Pearisburg; Hodge Cave, 1 mile east of Starnes Cave; Link Cave, Maybrook; Williams Cave, Maybrook; limestone cliffs

along Sinking Creek, 0.6 miles northeast of Newport; Newport Cave, Newport.

Eurycea lucifuga Rafinesque.—The specimen on which the first state record of this salamander was based was collected by Dunn (1936) at a cave on Sinking Creek, near Newport, in July, 1935. Fowler (1944) listed the cave salamander from five localities in Giles County. The author spent the summer of 1955 studying the ecology of this salamander in western Virginia and has several new localities for this species in Giles Co.: Adlai Jones Cave, 1 mile west-northwest of junction of boundaries of Giles, Craig, and Montgomery counties; Lucas Cave, Clover Hollow, 2.5 miles northeast of Newport; Link Cave, 0.5 miles south of Maybrook; Williams Cave, on Sinking Creek, Maybrook; Echols Hollow Cave, 0.5 miles north of Maybrook; Whittens Cave, on Sinking Creek, 0.7 miles east of Maybrook. Richard G. Zweifel found an individual of this species (AMNH 58236) in a limestone cliff along Sinking Creek, near Newport, on August 5, 1955, approximately 0.5 miles from the nearest known cave. A study of the habits, distribution, and ecology of *E. lucifuga* is now in progress, and the results will be reported at a future date.

Bufo terrestris americanus Holbrook.—Several toads heard calling on April 3, 1955, in low meadows in Clover Hollow were of this species. It is found sporadically throughout the county.

Bufo woodhousei fowleri Hinckley.—Two Fowler's toads have been taken. One small (39 mm.) individual was found along the muddy shore of New River near Ripplemead. A male 65 mm. in body length was captured at the Biological Station on August 23, 1954.

Hyla crucifer crucifer Wied.—Spring peepers were heard calling in the grassy margins of Sinking Creek, 1 mile east of Newport, on April 3, 1955.

Hyla versicolor versicolor Le Conte.—This tree frog is distributed throughout the county in suitable localities. Tree frogs are heard calling during June, July, and August on Salt Pond Mountain. Voices of this species were heard in Clover Hollow on August 19, 1955, and at Eggleston on September 10, 1955. Eggs were found in Francis Pond, near Newport, on July 30, 1954.

Rana catesbeiana Shaw.—The common bull frog is found along water courses and ponds in valleys throughout the county. It does not appear to be as common as the green frog. Individuals of this species which have been taken came from Newport Pond at Newport, Francis Pond at Newport, Sinking Creek 5 miles north of Newport, Wolf Creek at the Bland County line, and in Big Stony Creek at Kimballton.

Rana clamitans Latreille.—The green frog is the most often seen and heard salientian in the area. It is found in Mountain Lake and occurs in suitable places at all altitudes.

Rana sylvatica sylvatica Le Conte.—The wood frog is occasionally seen in damp woods at the higher elevations. A small individual of this species was seen in the upper entrance of Tawneys Cave on April 2, 1955. Re-

cently transformed frogs of this species were found at Little Meadows on August 5, 1954.

Rana pipiens pipiens Schreber.——Occasionally seen or heard in the grassy margins of slow-moving streams and low wet pastures, the leopard frog is unevenly distributed through the county. The only two specimens examined were taken from Sinking Creek 2.5 miles west of Maybrook.

Rana palustris Le Conte.——The pickerel frog is common about the margin of Mountain Lake and has been taken along small oxbow ponds at Little Meadows.

Chelydra serpentina serpentina Linnaeus.——The common snapping turtle is found in streams and ponds throughout the county. Several individuals have been seen in Mountain Lake, elevation 3970 feet. M. McDonald captured this species in Wolf Creek, August 19, 1885 (USNM 14422).

Sternotherus odoratus (Latreille).——One individual of this species has been taken in Wolf Creek near the Bland County line.

Terrapene carolina carolina (Linnaeus).——This is the most often seen reptile in the area. It is abundant throughout the county except on the higher peaks. One specimen was seen dead on the road about 200 yards south of the Mountain Lake Post Office at an elevation 3800 feet. Pope (1939) mentions that this species attains an altitude of 2500 feet in North Carolina. It is common on the slopes of John's Creek Mountain up to elevations of 2600 feet. Large numbers may be seen after heavy rains along the roads throughout the area. Fifteen were counted on the roads in a distance of 6.6 miles after a heavy rain on June 25, 1953.

Chrysemys picta picta (Schneider).——The painted turtle probably occurs in many of the ponds in the county, but the author has examined only one specimen. This individual came from a small artificial pond 1 mile west of Newport. Further collections need to be made in the county to determine if intergradation occurs with *C. p. marginata*, which is found in the neighboring counties of West Virginia, as shown by Carr (1952).

Sceloporus undulatus hyacinthinus (Green).——This lizard is common at elevations below 2500 feet throughout the county. Several persons have reported to the author that it occurs on Salt Pond Mountain, though extensive collecting there has produced no specimens.

Eumeces fasciatus (Linnaeus).——The five-lined skink has been taken at Bane beneath a pile of rotting lumber. This is the only time it has been seen, though it is common about lumber and sawdust piles in neighboring Craig and Montgomery Counties.

Natrix sipedon sipedon (Linnaeus).——This water snake is common throughout the county in the streams and ponds at lower elevations.

Natrix septemvittata (Say).——The queen snake is also abundantly distributed in the county and is to be found in the same situations as the common water snake.

Thamnophis sauritus sauritus (Linnaeus).——One individual was captur-

ed at the mouth of Spruce Run at New River beneath a large rock along the creek bank.

Thamnophis sirtalis sirtalis (Linnaeus).——The garter snake is common at all altitudes throughout the county. Localities for this species include Saltpeter Branch on Salt Pond Mountain, Sinking Creek near Newport, Bane, Hoge's Store, 0.5 miles west of Bluff City, and Wind Rock.

Diadophis punctatus edwardsi (Merrem).——Twelve specimens have been examined from various localities in the county. A very large individual of this species was seen in a crevice of the twilight zone at Williams Cave, Maybrook.

Carphophis amoenus amoenus (Say).——The worm snake has been found in one locality in the county, though it is doubtlessly more widespread than the one record would indicate. This snake was taken beneath old boards at Inwod Farms, Clover Hollow.

Coluber constrictor constrictor Linnaeus.——Only one individual of this species has been seen by the author. A dead specimen was found on the road at Hoge's Store in July, 1955. It is not common in the county and Uhler, Cottam, and Clarke (1939) state that it is relatively rare in the George Washington National Forest in northwestern Virginia.

Elaphe obsoleta obsoleta (Say).——The pilot blacksnake appears to be very common in the county, 21 dead specimens being seen on roads during June, July, and August, 1955. One was taken just within the mouth of Lucas Cave, Clover Hollow, on July 29, 1955.

Pituophis melanoleucus melanoleucus (Daudin).——Burch (1940) reported the northern pine snake from Giles and Craig Counties.

Lampropeltis doliata triangulum (Lacepede).——The milk snake is fairly common in the vicinity of the Biological Station and has been taken at Maybrook, 2 miles south of Pearisburg, and on Salt Pond Mountain near Bald Knob.

Ancistrodon contortrix mokeson (Daudin).——The copperhead is found in the valleys throughout the county. The author has seen only three specimens, all from the vicinity of Newport, but farmers throughout the county report that this snake is common. There are three records from the Biological Station and Salt Pond Mountain (Wood, 1954).

Crotalus horridus horridus Linnaeus.——The timber rattlesnake appears to be quite common, especially on Salt Pond Mountain and the upper half of Sinking Creek Valley in Giles County. Eleven specimens of this species from Salt Pond Mountain have been examined. All but three of these were of the dark form, four being almost black. Smyth (1949) gives the food items for 19 of these snakes taken at the Biological Station.

SUMMARY

1. The present known herpetofauna of Giles County includes 16 salamanders, 9 frogs and toads, 4 turtles, 2 lizards ,and 13 snakes.

2. Notes on relative abundance, distribution, and localities are given for each species.
3. A range extension for *Ambystoma jeffersonianum* is given.

ACKNOWLEDGMENTS

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LITERATURE CITED

BISHOP, SHERMAN C. 1943. Handbook of Salamanders. Ithaca (New York): *Comstock Publ. Co.*, p. 1-xiv, 1-555, fig. 1-144, maps 1-56.

BOGERT, CHARLES M. 1952. Relative abundance, habits, and normal thermal levels of some Virginia Salamanders. *Ecol.*, 33: 16-30.

BURCH, PAUL R. 1940. Snakes of the Allegheny Plateau in Virginia. *Va. Jour. Sci.*, 1: 35-40.

CARR, ARCHIE. 1952. Handbook of Turtles. Ithaca (New York): *Comstock Publ. Co.*, p. i-xv, 552, fig. 1-37 ,maps 1-23.

CARROLL, R. P. 1950. Amphibia and Reptiles. Section in James River Basin; Past, Present, and Future. *Va. Acad. Sci.*, Richmond.

DUNN, EMMET R. 1936. List of Virginia Amphibians and Reptiles. *Mimeographed,* Haverford, Pennsylvania.

FOWLER, JAMES A. 1944. The Cave Salamander in Virginia. *Proc. Biol. Soc. Washington,* 57: 31-32.

NEWMAN, WALTER B. 1954. A New Plethodontid Salamander from Southwestern Virginia. *Herpetologica,* 10: 9-14.

POPE, CLIFFORD H. 1939. Turtles of the United States and Canada. New York: *Alfred A. Knopf,* p. i-xvii, 1-343, fig. 1-99, table.

..... 1949. Notes on Growth and Reproduction of the Slimy Salamander *Plethodon glutinosus. Fieldiana, Zool.,* 31: 25-261, fig. 60-65.

SMYTH, THOMAS. 1949. Notes on the Timber Rattlesnake at Mountain Lake, Virginia. *Copeia,* (1): 78.

UHLER, F. M., C. COTTAM, AND T. E. CLARKE. 1939. Food of Snakes of the George Washington National Forest, Virginia. *Trans. 4th N. A. Wildlife Conf.*, p. 605-622.

WOOD, JOHN T. 1954. The Distribution of Poisonous Snakes in Virginia. *Va. Jour. Sci.*, 5: 152-167.

Land Snails of Nansemond, Norfolk, and Princess Anne Counties, Virginia

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Associates of the Norfolk Museum of Arts and Sciences

Mr. John B. Burch's article, "The Land Snails of Hanover, Henrico, and Chesterfield Counties, Virginia," which appeared in the July 1955 issue of the *Virginia Journal of Science*, inspired us to publish our findings in the Coastal Plain counties of Nansemond, Norfolk, and Princess Anne. While the present report is based on collections made over a five-year period it should be understood that the entire area has not yet been thoroughly worked, and it is anticipated that at some future date a more exhaustive report will be made.

Field work in this area indicates a greater concentration of animals and a greater variety of species in vacant lots in and around the city of Norfolk than in the wilder areas of the region. Several of the species found around Norfolk were introduced from Europe or Asia. This city has always been a large, sprawling one, with many wooded and grassy vacant lots scattered throughout. In recent years, however, there has been a marked increase in residential development within the city; many of the lots have been cleared and waste land is being reclaimed.

ANNOTATED LIST

Helicella caperata (Montagu)——Abundant in grassy vacant lots in and around the city of Norfolk.

Helix aspersa (Muller)——One large colony at York and Dunmore Streets, Norfolk. Also scattered throughout the older portion of town.

Anguispira fergusoni (Bland)——Abundant in wooded lots in Norfolk; uncommon elsewhere.

Discus cronkhitei (Newcomb).

Helicodiscus parallelus (Say).

Helicodiscus singleyanus inermis H. B. Baker.

Haplotrema concavum (Say)——Common in Dismal Swamp.

Mesodon thyroidus (Say)——Common everywhere.

Mesodon appressus sculptior (Chadwick)——Uncommon.

Stenotrema hirsuta (Say)——A solitary dead shell found at Wallaceton, Norfolk County.

Triodopsis a. albolabris (Say)——Uncommon.

Triodopsis albolabris traversensis (Walker).

Triodopsis fallax (Say)——Found only at Virginia Beach, Princess Anne County.

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Triodopsis hopetonensis (Shuttleworth)——Abundant (seems to abound near salt or brackish water). Especially numerous at Back Bay Wildlife Refuge, Sandbridge, Princess Anne County; and Ghent district of Norfolk.

Triodopsis tridentata juxtidens (Pilsbry)——Plentiful at Stumpy Lake, Norfolk County; Edgewater district of Norfolk; South Norfolk; and Dismal Swamp, Nansemond County.

Hawaiia minuscula (Binney).

Retinella i. indentata (Say).

Retinella indentata paucilirata (Morelet).

Ventridens cerinoideus (Anthony)——Most abundant snail in the Dismal Swamp, where it frequents the moist areas.

Ventridens ligerus (Say)——Abundant in city of Norfolk; Dismal Swamp, Nansemond County.

Ventridens ligerus form *sagdaoides* Gratacap——One dead shell from wooded lot off 900 block of Raleigh Avenue, city of Norfolk.

Zonitoides arboreus (Say)——Common.

Oxychilus draparnaldi (Beck)——Colonial in city of Norfolk; abundant when found.

Striatura meridionalis (Pilsbry and Ferriss)——Found only at Broadmoor, Norfolk County. Fungivorous; obtained by scraping fungi from dead leaves.

Gastrocopta armifera (Say).

Gastrocopta contracta (Say).

Gastrocopta procera (Gould).

Pupoides albilabris (C. B. Adams).

Pupoides marginatus (Say).

Strobilops aenea Pilsbry.

Strobilops labyrinthica (Say).

Vallonia costata (Muller).

Vallonia excentrica Sterki.

Rumina decollata (Linnaeus)——Colonies are scattered in Norfolk, but the snails are abundant once located. Especially numerous at Southampton and Hermon Avenues, Norfolk.

Opeas pyrgula (Schmacker and Boettger)——Abundant in wooded lot off 900 block of Boissevain Avenue, Norfolk.

Cionella lubrica (Muller)——Abundant in wooded lot off 900 block of Boissevain Avenue, Norfolk.

Succinea aurea Lea.

Succinea avara Say.

Pallifera fosteri F. C. Baker——Common everywhere.

Pallifera mutabilis Hubricht.

Pallifera varia Hubricht——Common in and around Dismal Swamp. Usually collected on tree trunks. Seems to be more arboreal than the other species.

Deroceras laevae (Muller)——Very common in Dismal Swamp.

Deroceras reticulatum (Muller)——Common in Dismal Swamp.

Limax flavus Linnaeus.

Limax maximus Linnaeus——Common in city of Norfolk.

Milax gagates (Draper).

Carychium exile H. C. Lea——One living specimen in golden mouse nest seven feet above ground, Dismal Swamp, near Magnolia, Nansemond County.

A total of forty-seven species and races have been collected. Duplicate lots have been contributed to the United States National Museum, Academy of Natural Sciences of Philadelphia, Museum of Comparative Zoology at Harvard College, and Chicago Natural History Museum. There remain additional species listed as present in this region by other field workers, but which the writers have not yet found. For the present, we sincerely hope that this paper, together with the excellent one by Mr. Burch, may serve as a stimulus for others to report distributional records of the snails of their respective counties. Eventually, we hope to see "The Land Snails of Virginia" in print.

The writers wish to thank Dr. Joseph P. E. Morrison, Associate Curator, Division of Mollusks, U. S. National Museum, for checking and identifying their specimens.

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REFERENCES

ABBOTT, R. TUCKER. 1950. Snail Invaders. *Natural History*, 59(2): 80-85.

BAKER, FRANK COLLINS. 1939. Fieldbook of Illinois Land Snails. *Illinois Natural History Survey*, Manual 2, pp. 1-166.

BURCH, PAUL R. 1950. Mollusks. In The James River Basin —— Past, Present, and Future. *Virginia Academy of Science*, pp. 129-137.

FRANZEN, DOROTHEA S. AND LEONARD, A. BYRON. 1947. Fossil and Living Pupillidae (*Gastrocopta* = *Pulmonata*) in Kansas. *Univ. Kansas Sci. Bull.* 31(15): 311-411.

HUBRICHT, LESLIE. 1953. Land Snails of the South Atlantic Coastal Plain. *Nautilus*, 66(4): 114-125.

MACMILLAN, GORDON K. 1949. The Land Snails of West Virginia. *Annals of the Carnegie Museum*, 31 (Art. 7): 89-237 + iv.

PILSBRY, HENRY A. 1939-1948. Land Mollusca of North America. *Acad. Nat. Sci., Philad.* Vols. 1 and 2.

REHDER, HAROLD A. 1949. Some Land and Freshwater Mollusks from the Coastal Region of Virginia and North and South Carolina. *Nautilus*, 62(4): 121-126.

News and Notes

(Editor's Note: News contributions should be sent to the person whose name appear at the end of the appropriate sections.)

THE DISTRIBUTION OF THE VIRGINIA JOURNAL OF SCIENCE

At a meeting of the Editorial Staff of the Virginia Journal of Science held in Charlottesville on December 4, 1955, it was suggested that a report be made to the members of the Academy concerning the circulation of the Journal.

In 1950, when the new series of the Journal was first established, the Alderman Library at the University of Virginia was awarded exclusive exchange rights. This in no way infringes on the prerogative of securing subscriptions from libraries of universities, colleges, and industrial organizations or from individuals. It does, on the other hand, aid in a wider circulation of the Journal. The Alderman Library purchases 125 copies of each issue of the Journal, and these are sent in exchange for scientific periodicals both in the United States, and 14 foreign countries. The Journal is also received by approximately 975 indiivduals and industrial organizations.

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While this is a modest distribution the Editorial Staff makes this report with a certain amount of pride. It must be realized that the Journal is a young publication and is suffering the growing pains of youth. Nevertheless, it is growing in every way, and with the aid of the membership, particularly those with established reputations in their chosen fields, in contributing an occasional article of importance, the Journal would enjoy a wider circulation and a greater prestige.

There are certain features of the Journal that while not unique should be attractive to contributors. At the present time rapid publication can be assured. The cost of printing, and particularly cost of reprints, compares favorably with those of most journals. Publication in the Journal not only reflects credit on the individual, his institution, and the State of Virginia but also furthers the cause of the Virginia Academy of Science.

The Editors

NOTICE TO ACADEMY OFFICERS, SECTION OFFICERS, AND COMMITTEE CHAIRMEN

Anyone desiring stationery of the Virginia Academy of Science, including envelopes addressed to Academy members, please forward your request to:

William B. Wartman, Jr., Assistant Secretary
Box 4178
Richmond, Virginia

CIVIL SERVICE COMMISSION ANNOUNCEMENT

There is an urgent need for Chemists, Mathematicians, Metallurgists, Physicists, and Electronic Scientists in the Washington, D. C., area, the United States Civil Service Commission has announced. Vacancies are in various Federal agencies and pay salaries ranging from $4,345 to $11,610 a year. No written test is required. Further information and application forms may be obtained by writing to the U. S. Civil Service Commission, Washington 25, D. C. Applicants should ask for Announcement No. 46(B).

NOTICE TO SCIENCE TEACHERS

A new and unique program to assistant secondary schools in science teaching has just been announced by the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tennessee. The program, which is jointly sponsored by the National Science Foundation and the U. S. Atomic Energy Commission, and administered by the Institute, will enable a selected group of high-school teachers to undergo a three-month course of training in Oak Ridge, and then spend nine months in traveling about the country giving lecture demonstrations in science classes at individual high schools.

A group of from eight to ten secondary-school science teachers will be selected on a national basis by ORINS with the recommendation and advice of a selection committee which will include, among others, high-school teachers and administrators. Beginning with the summer of this year, this group will receive leaves of absence from their respective schools for the academic year only, returning to their normal teaching positions in September of 1957.

The Oak Ridge program will begin with the group's participation in a four-week institute to be held at the ORINS Special Training Division in Oak Ridge. During the four weeks following the institute, which will end early in July, the selected group will participate in a program designed to acquaint its members with modern laboratory techniques and experiments. This period will include visits to specific laboratories, work with

demonstration equipment, supervised self-training, and some practice teaching.

The third phase of the program will send the teachers "on the road." Each one will be provided with a station wagon and demonstration equipment consisting of easily transportable classroom aids in physics and chemistry. Until the end of May, 1957, the teachers will spend their working days visiting high schools in the areas assigned to them, giving classroom demonstration lectures at the sophomore-junior level. It is anticipated that each teacher will spend one week at a single high school, where he may give two to three lectures per day three to five days during the school week. The teacher might also be available for consultation with other science teachers or school administration.

A particularly pleasant feature of the program will be the assignment of each teacher to a district where he may use his home town as a base of operations, thus enabling him to spend his week ends and possibly many evenings with his family. The touring portion of the program will end late in May, 1957. From then until June 15, the teachers will prepare individual reports on the program and will participate in an evaluation study. It is also planned that, at the conclusion of the program, the demonstration equipment will be presented to the science departments of the high schools whose representatives participated in the program.

During the academic year, the touring teachers will receive a stipend at least equal to their regular teaching salaries. In addition, it is planned to provide a travel allowance to cover expenses while the various schools are being visited. The stipends and travel expenses will be paid by the NSF.

SCIENCE FAIRS

Three booklets designed for science teachers, educators, and others who are interested in the planning of science fairs have been published and are now available free of charge from state academies of science in 11 states.

The booklets, "Science-Fair Handbook for Exhibitors," "Science-Fair Handbook for Teachers," and "A Manual for Science Fairs," have been prepared by the Educational Section of the American Museum of Atomic Energy in Oak Ridge, Tennessee. They have been written to aid students as well as teachers who may want help in initiating new fairs, or who may want to improve existing fairs.

Concerned over the present and projected national disparity between the need for scientists and the number of students electing to study for scientific careers, the Oak Ridge Institute of Nuclear Studies (which operates the museum) recently established a program to aid the development of science fairs in the south and southeast. The Museum Division of ORINS is conducting the program, as a public service, in the conviction that the science fair is one of the best methods of stimulating student interest in science.

In addition to receiving the booklets, state academies of science in

Florida, Mississippi, Oklahoma, Alabama, Louisiana, Texas, Arkansas, Georgia, West Virginia, and South Carolina have also received from ORINS a number of 35-millimeter Kodachrome slides dealing with various aspects of science-fair activity, which are available on a loan basis without charge.

SECTION NEWS

AGRICULTURAL SCIENCE SECTION

Members of the Animal Husbandry Department of Virginia Polytechnic Institute who attended the Southern Agricultural Workers annual meeting and who gave papers on the program were Jack C. Taylor, Dr. W. S. Wilkinson, Dr. T. J. Marlow, and Dr. Martin J. Burris.

Dr. C. M. Kincaid resigned from the Department of Animal Husbandry, Virginia Polytechnic Institute, on January 1 to become coordinator for the Southern Regional S-10 Breeding Program with headquarters at University of Tennessee, Knoxville.

Dr. W. S. Wilkinson, joint employee between the Department of Animal Husbandry and Biochemistry, resigned March 10 to become Poultry Nutritionist with the Department of Poultry Husbandry at Louisiana State University, Baton Rouge.

The new meats processing laboratory at Virginia Polytechnic Institute has been in operation since January 1 and is considered a valuable addition to the research program in animal husbandry.

Dr. Douglas F. Watson, an Animal Husbandry student from the University of Maryland and a graduate from the University of Pennsylvania School of Veterinary Medicine, has been added to the staff of the Biology Department, Virginia Polytechnic Institute, as of January 1, 1956. Dr. Watson was engaged in the private practice of veterinary medicine at Pulaski, Virginia, for four years prior to World War II. He spent five years in the Veterinary Corps of the Army of the United States. Following this, he spent nine years in Lima, Peru, in charge of the health of the herds and flocks belonging to the Cerro de Pasco Copper Corporation.

Dr. Darwin E. Norby was appointed as geneticist to the staff of the Biology Department as of January 1, 1956, to replace Dr. Max Levitan who resigned to go to the Woman's Medical College of Pennsylvania. Dr. Norby had his major training at the University of Indiana and did work under Drs. Cleland and Muller. He then spent two years in the Department of Genetics at Iowa State College.

W. S. Griffith was appointed Assistant Professor of Dairy Science at Virginia Polytechnic Institute, November 1, 1955. He received his B.S. degree from Pennsylvania State University and his M.S. degree from Louisiana State University. His work deals with the testing, feeding and management project in the dairy extension program.

Six members of the Department of Dairy Science, Virginia Polytechnic Institute, attended the annual meeting of the Association of Southern Agricultural Workers in Atlanta in February. They presented five papers at the Southern Section of the American Dairy Science Association held at

the same time. Those attending were Drs. Graf, Hardison, Thompson, Stone, Baldwin, and Professor Reaves.

A new Rogers spray milk dryer was installed in the Dairy Science building recently at Virginia Polytechnic Institute. This piece of equipment will greatly facilitate the research work in dried milk and milk products recently initiated in the Department of Dairy Science. The project leader is Dr. W. K. Stone. Very few colleges have this equipment in their dairy processing plants. The dryer will also be used to train dairy students in the operation and maintenance of a spray dryer. Surplus milk produced by the college herd will also be more efficiently handled when it is in the dried form.

Virginia Polytechnic Institute Dairy Science students received the Borden Foundation Scholarship Award and the Ralston-Purina Scholarship Award. The Borden Foundation Award of $300 went to A. H. Rakes, and the Ralston-Purina Award of $500 went to W. B. Allison, Jr. Both of these students are seniors and plan to pursue graduate work.

Among the members of the Virginia Polytechnic Institute Poultry Department staff attending the meetings of the Association of Southern Agricultural Workers in Atlanta, Georgia, February 6, 7, and 8, were Dr. James H. Bywaters and Professor E. O. Essary. Professor Essary spoke on the "Problems and Recent Advances in Poultry Marketing Technology". Dr. Bywaters, as Secretary of the Poultry Section, organized and planned the two and one-half day poultry program. He is a member of the Poultry Section Coordinating Committee and was elected Vice-Chairman of the Poultry Section for 1957.

Dr. Clayton E. Holmes of the Poultry Department of Virginia Polytechnic Institute attended the Distiller's Feed Conference in Cincinnati, Ohio, on March 7, 1956.

Dr. E. L. Wisman discussed, "Utilization of By-Products from Poultry Plants in Chick Ration", at the Virginia Nutrition School for Feed Men in Roanoke on February 22.

Recent publications of the Department of Biochemistry and Nutrition at Virginia Polytechnic Institute are as follows: Variety, Type, Year and Location Effects on the Chemical Composition of Peanuts. James F. Eheart, R. W. Young, and Allen H. Allison. *Food Research 20*, 497-505 (1955). Crop, Light Intensity, Soil pH, and Minor Element Effects on the Yield and Vitamin Content of Turnip Greens. James F. Eheart, R. W. Young, P. H. Massey, Jr., and J. R. Havis. *Food Research 20*, 575-581 (1955). Palatability and Chemical Differences in Cooked Smithfield Hams from Full-fed Hogs on Peanut and Corn Rations. Mary S. Eheart, H. R. Thomas, and J. C. Taylor. *Food Research 20*, 548-553 (1955). Comparisons of Two Media Proposed for the Isolation of Bacteria from the Rumen. Kendall W. King and Paul H. Smith. *J. Bact. 70*, 726-729 (1955).

Plans are well underway for a human nutrition study which will be conducted cooperatively between Biochemistry and Nutrition and Home

Economics during the summer months. Under this regional project, the Virginia Agricultural Experiment Station will be determining the copper, cobalt, molybdenum, and zinc balance of 7- to 9-year-old girls.

A grant in the amount of $2800 has been made available to the Department of Biochemistry and Nutrition, Virginia Polytechnic Institute, by E. I. duPont de Nemours and Company, Inc., for investigation of "Nitrogenous Nutritional Requirements of Cellulolytic Rumen Bacteria". Fellow is J. W. Gill.

Another grant has been made available to the Department of Biochemistry and Nutrition by the National Science Foundation for investigation of "Significance of the Cellulodextrins Produced during Enzymatic Hydrolysis of Cellulose". Fellows are F. H. Hulcher and J. H. Hash.

Dr. J. L. Maxton, extension economist at Virginia Polytechnic Institute, is on a year's leave of absence working for F.A.O. in Southern Rhodesia.

Dr. T. E. Tramel resigned from the Department of Agricultural Economics, Virginia Polytechnic Institute, February 1 to return to Mississippi State College.

Drs. Carl W. Allen, John T. Buck, W. L. Gibson, Jr., and Peter L. Henderson of Agricultural Economics Department, Virginia Polytechnic Institute, attended the Association of Southern Agricultural Workers meetings in Atlanta in February. Dr. Allen was the 1955-56 Chairman of the Agricultural Economics and Rural Sociology Section and is on the Board of Directors of the Association. Drs. Buck, Gibson and Henderson spoke on various aspects of research work in which they are engaged.

During the past year, the Virginia Polytechnic Institute Agricultural Extension Service has been putting forth a great deal of effort in developing a procedure for sound Extension program planning at the county level. The key to this procedure is the involving of lay people, the determining of major problems in agriculture and home economics, the determining of what can be done to solve these problems and the setting of goals.

Martha G. Creighton, Professor of Home Economics Education, Virginia Polytechnic Institute, attended the Southern Regional Conference of Home Economics teachers in Memphis during February. With Miss Catherine Dennis, State Supervisor of Home Economics in North Carolina, Miss Creighton made a report on the White House Conference on Education which she attended as a representative of the American Vocational Association.

T. J. Horne, Professor of Agricultural Education, B. C. Bass, Associate Professor of Agricultural Education, and H. W. Sanders, Professor of Vocational Education, attended the Southern Regional Conference of workers in Agricultural Education, held in Houston, Texas, March 19-22.

Preliminary copies of the research study, "What Constitutes an Effective Program of Vocational Agriculture in a Community", planned and completed under the direction of the Southern Regional Research Committee of the Vocational Agricultural workers of the twelve southern states and Puerto Rico, were distributed to selected members who submitted a report on the Study at the Regional Conference in Houston, Texas. Dr. Horne

is Chairman of the Research Committee of the Southern Region and a member of the National Research Committee.

As fiscal officer of the Southern Association of Agricultural Engineers and Vocational Agriculture, H. W. Sanders presented the annual report of the Association. He also conducted a panel discussion with representatives from six southern States on "Teaching Farm Mechanics in Terms of Actual Farm Problems". Dr. Bass represented Virginia on a committee assigned the study of "What Competencies Are We Trying to Develop in the Under-graduate Program for Training Teachers of Vocational Agriculture?"

—CARL W. ALLEN, *Virginia Polytechnic Institute*

ASTRONOMY, MATHEMATICS AND PHYSICS SECTION

Dr. Edward J. McShane is spending the current university session at the University of Utrecht in the Netherlands, where he is doing research and teaching.

Dr. W. L. Duren, formerly of the Department of Mathematics of Tulane University, is the newly-appointed Dean of the College of Arts and Sciences at the University of Virginia. He also serves as a member of the faculty of the Department of Mathematics.

Dr. Marvin Rosenbloom who received his Ph.D. at the University of California has joined the faculty of the Department of Mathematics at the University of Virginia as an Assistant Professor.

Dr. Walter Aron has been appointed to an Assistant Professorship in Physics at the University of Virginia. Dr. Aron received his Ph.D. from the University of California, and for two years was a Research Associate at Princeton University prior to coming to Virginia.

Dr. Edward C. Booth currently holds a Post-doctoral Fellowship in the Physics Department at the University of Virginia, where he is doing research in nuclear physics. Dr. Booth received his Ph.D. from Johns Hopkins University.

Dr. Stephan Berko is the principal investigator under a new Office of Naval Research Contract recently awarded to the University of Virginia. This contract will support experimental studies of the interactions of positrons in matter.

The Office of Ordnance Research for the United States Army has also awarded a contract to the University for nuclear physics research, using a Van der Graaf machine. The machine itself was purchased under an Atomic Energy Commission Contract.

Dr. J. W. Beams is currently serving on the General Advisory Committee of the Atomic Energy Commission.

Dr. William J. Archibald who received his Ph.D. in Physics at the University of Virginia, and was recently a Post-doctoral Fellow there, has been appointed Dean of the College of Arts and Sciences at Dalhousie University.

The Leander McCormick Observatory

Prof. H. L. Alden attended the session of the International Astronomical Union in Dublin in September, 1955, and visited several English and Irish Observatories.

Dr. H. K. Eichhorn is a visiting astronomer at the Observatory. He came here in June, 1954, and is planning to stay here until next summer. His principal interest is in positions and motions of Open Clusters.

Mr. A. G. A. Balz, Jr., Research Assistant, has classified to date 22,452 spectra of faint stars for an international catalogue of positions and motions of faint stars to be prepared in Hamburg, Germany. Mr. Balz has been recently appointed a Junior Observer at the Lick Observatory of the University of California, where he is due to begin his work next September.

Five papers concerning the motions and distribution of Dwarf M Stars are in press. These are the result of an intensive study of these stars which Dr. A. N. Vyssotsky and his collaborators have been conducting for the past ten years.

BACTERIOLOGY SECTION

Dr. Holmes T. Knighton of the Department of Microbiology, Medical College of Virginia, presented a report on the *Status of Topical Antibiotics in the Practice of Dentistry* at the annual meeting of the Council on Dental Therapeutics of the American Dental Association held in Chicago in February.

Mr. William A. Dorsey, Chief of the Public Health Laboratory in Richmond, has been elected to the Executive Committee of the Conference of State and Provincial Laboratory Directors, and was named a member of the Executive Council of the Virginia Public Health Association.

—P. ARNE HANSEN, *College Park, Maryland*

BIOLOGY SECTION

The following additions to the Faculty of the Department of Biology, University of Virginia, were announced in February:

Mr. William A. Jensen, as Assistant Professor of Biology, who will offer work in Plant Anatomy, Morphogenesis, and Cytochemistry. Mr. Jensen received his Ph.D. degree from the University of Chicago and has subsequently been associated with the California Institute of Technology. He is now on leave-of-absence for study in Brussels.

Mr. Samuel P. Maroney, as Assistant Professor of Biology, who will offer work in General and Animal Physiology. Mr. Maroney comes from Wesleyan University of Delaware, and Duke University. His interest is primarily in physiological problems at the cellular level.

The staff of the Virginia Fisheries Laboratory has been augmented recently by two new appointments. Dr. William J. Hargis, Jr., joined

the staff in September, 1955, and James P. Whitcomb arrived in February, 1956.

Dr. Hargis obtained his Master's degree from the University of Richmond and his Ph.D. from Florida State University. In 1955 he taught biology at the Citadel, Charleston, S. C. He has specialized in the systematics, phylogeny, and host-specificity of the trematode parasites of fishes. His new duties are concerned primarily with the life-histories of oyster drills, but he is continuing his studies of fish parasites.

Mr. Whitcomb, a graduate of Alfred University in New York State, came to the Laboratory from Woods Hole, Massachusetts, where he served on the staff of the Marine Biological Laboratory for five years. He will be employed in studies of the commercial pound-net and haul-seine fisheries.

The Laboratory executed a contract in February 1956 for the construction of a 55-foot wooden research vessel. Similar in design to a southern shrimp-trawler, the boat will have living accommodations below decks for six people, and a laboratory on the main deck. She probably will be launched in the fall of 1956.

—ROBERT T. BRUMFIELD, *Longwood College*

ENGINEERING SECTION

Dr. John W. Whittemore, dean of Engineering and Architecture at Virginia Polytechnic Institute was elected chairman of the engineering division of the Association of Land Grant Colleges and Universities at the annual meeting of this association held at Michigan State University.

Professor Dan Frederick of the Applied Mechanics Department at Virginia Polytechnic Institute presented a paper at the annual meeting of the American Society of Civil Engineers entitled "Analysis of Thick Rectangular Plates," which has been published in the Proceedings of the ASCE. Dr. Frederick also presented a paper entitled "On Some Problems in the Bending of Thick Circular Plates," at the Diamond Jubilee Meeting of the American Society of Mechanical Engineers held at Chicago in November, 1955.

Professor R. C. Brinker, head of the Civil Engineering Department at Virginia Polytechnic Institute, has co-authored a new textbook, "Elementary Surveying," published by the International Textbook Company. Professor Brinker also published an article describing the work offered at Virginia Polytechnic Institute in Municipal Engineering in the December issue of the "Virginia Municipal Review."

Professor Robert W. Truitt of the Aeronautical Engineering Department at Virginia Polytechnic Institute presented a paper, "Investigation of Wedges in Transonic Flow at Small Angle of Attack," at the Midwestern Conference on Fluid Mechanics at Purdue University. Dr. Truitt also attended the annual meeting of the Institute of the Aeronautical Sciences in New York City in January.

General Stewart W. Anderson, head of the Department of Mechanics and Drawing at Virginia Military Institute, participated in the Conference

on Thermodynamics held at Pennsylvania State University. He also attended the annual meeting of the Southern Association of Colleges and Secondary Schools held in December in Miami, Florida. General Anderson and Capt. D. M. Crim of the Civil Engineering Department attended the meeting of the Virginia Highway Conference held at Virginia Military Institute in November, 1955.

Mr. Tilton E. Shelburne, director of the Virginia Council of Highway Investigation and Research at the University of Virginia, attended the 35th annual meeting of the Highway Research Board in January at which he received the Roy W. Crum Award for Distinguished Service in Recognition of Outstanding Achievement in the Field of Highway Research.

Professor O. L. Updike, Jr. of the Chemical Engineering Department at the University of Virginia presented a paper on "Guidance Systems" at the meeting of the North Carolina-Virginia Section of the Institute of Radio Engineers in November, 1955. He also presented a paper jointly with John H. McLeod, Jr., entitled "A Comparison of Diode Switching Methods for Analog Function Generation", at the National Simulation Conference held at Dallas, Texas, in January. Both Dr. Updike and Professor R. M. Hubbard of the Chemical Engineering Department of the University of Virginia attended the annual meeting of the American Institute of Chemical Engineers held in November at Detroit, Michigan. At this time Dr. Updike visited the computing facilities of the University of Michigan.

—ROBERT M. HUBBARD, *University of Virginia*

GEOLOGY SECTION

The Department of Geology at the University of Virginia has recently purchased a high temperature muffle furnace to be used in several research problems which have been planned by Richard S. Mitchell, Assistant Professor of Petrology and Mineralogy. One of these deals with the synthesis of various sulfide crystals which will be subjected to X-ray analysis. The relationship of twinning, polymorphism, and polytypism to the recent theory of the spiral growth of crystals will also be considered. In addition, the Department has purchased a 57.3 mm. powder X-ray camera to supplement its other X-ray equipment. A mechanical calculator has also been purchased to aid in the determination of crystal structures.

Raymond S. Edmundson, a member of the steering Committee on Geology as applied to Highway Engineering, attended the seventh annual Symposium, held in Raleigh, N. C., on February 23 and 24.

Ralph L. Miller, Chief of the Fuels Branch, U. S. Geological Survey, will speak at the Geology Symposium held in connection with Virginia Polytechnic Institute's Annual Engineering Emphasis Week Program. The symposium will be held in Holden Hall at 1:45 P.M., April 27. You are invited to attend.

Leonard Harris of the U. S. Geological Survey has completed field mapping of and is preparing a report on the Duffield quadrangle in Lee

and Scott counties, Virginia. Plans call for his mapping the adjacent Stickleyville quadrangle.

Art Boucot of the U. S. Geological Survey visited the Virginia Polytechnic Institute Department of Geological Sciences February 24 and 25. Dr. Boucot who will join the Massachusetts Institute of Technology staff this fall, accompanied John W. Murray of the Virginia Polytechnic Institute Chemistry Department and members of the Department of Geological Sciences on a visit to one of the nearby caves to collect rare minerals. The occurrence of these minerals is the subject of a paper by John W. Murray and R. V. Dietrich. The paper will appear in the *American Mineralogist*.

Dr. Donald F. Squires, Assistant Curator of Invertebrate Fossils, American Museum of Natural History, New York City, discussed the "Ecology of Coral Reefs" at a special meeting of the Holden Society of Virginia Polytechnic Institute, February 17. Squires' talk was based on his experiences on Arno Atoll in the Marshall Islands of the South Pacific. He illustrated his lecture with an array of kodachrome slides.

A "Report of Radimetric Reconnaissance in Virginia, North Carolina, Eastern Tennessee, and Parts of South Carolina, Georgia, and Alabama" by Marcellus H. Stow was published in January, 1956, as U. S. Atomic Energy Commission RME-3107.

A field conference on the Pleistocene stratigraphy of the Coastal Plain of Virginia was conducted by Wayne E. Moore on December 12, 13, and 14, 1955. John T. Hack, Allen Sinnott, and G. C. Tibbitts, Jr., all of the U. S. Geological Survey, S. S. Obenshain, Charles I. Rich, and R. D. Krebs, Virginia Polytechnic Institute soil scientists, and Bruce W. Nelson of the Virginia Polytechnic Institute Department of Geological Sciences participated in the conference. H. C. Porter and Walter Creggar have begun their mapping of the soils of Montgomery County as part of the State Soil Survey.

"The Geology of Jackson County, Florida" by Wayne E. Moore has been published as Bulletin 37 of the Florida Geological Survey, Tallahassee, Florida. His paper emphasizes the ecological aspects of the late Eocene foraminiferal faunas and points out the influence of contemporaneous tectonic movement.

"Primary Dolomite?" is the subject of an article by B. N. Cooper which appears in the March issue of the *Mineral Industrial Journal*.

"Factors in Loss of Porosity by Quartzose Sandstones of Western Virginia" are discussed by W. D. Lowry in an article in the March issue of the A.A.P.G. Bulletin.

C. Cole Fisher, Technical Editor and Mineral Economist, resigned from the Staff of the Division of Geology on September 2, 1955, to accept a position in research work with Metal Research Laboratories at Niagara Falls, N. Y.

Vernon R. Geyer, Ground-Water Geologist, resigned on January 15, 1956, to accept a position as geologist with Roland F. Beers and Asso-

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ciates. In his new position, Mr. Geyer will be in charge of geological investigations of metallic and nonmetallic mineral resources for the company in Virginia and other southeastern states.

Edwin O. Gooch is making a preliminary investigation of vermiculite in the Piedmont region of the State. It is expected that the results of the investigation will be published by the Division by the middle of the summer.

Robert S. Young, Wilbur T. Harnsberger, and William M. McGill attended, on November 18, 1955, the annual meeting of the Appalachian Geological Society held at the Daniel Boone Hotel in Charleston, West Virginia. At that meeting, Professor Wallace D. Lowry of the Department of Geological Sciences of Virginia Polytechnic Institute presented a paper on "Factors in Loss of Porosity by Quartzose Sandstones of Western Virginia."

William M. McGill was elected to complete the unexpired term of Watson Monroe of the U. S. Geological Survey, as Senior Representative of the Capitol District of the American Association of Petroleum Geologists.

Robert S. Young and William M. McGill attended a joint meeting of the Geological Society of Washington and the Capitol District of the American Association of Petroleum Geologists, held at the Cosmos Club in Washington on the evening of February 8, at which Mr. Moses Knebel, Vice-President of the Standard Oil Company of New Jersey and President of the American Association of Petroleum Geologists, gave a very interesting talk, accompanied by colored slides, on the "Habitats of Oil".

Robert S. Young attended, as a representative of the Virginia Division of Geology, meetings of the American Institute of Mining and Metallurgical Engineers, held in New York City, February 19-23. He also attended, from November 6-9, 1955, the annual meeting of the Geological Society of America, held in New Orleans, Louisiana.

—W. D. LOWRY, *Virginia Polytechnic Institute*

PSYCHOLOGY SECTION

The Constitutional Committee of the Psychology Section has drawn up a tentative Constitution for the establishment of a Virginia Psychological Association. The report of the work of this Committee will be given by its Chairman, Dr. William J. Morgan, at the annual meeting of the Section in May.

Dr. David H. Orr has resigned as Chief Psychologist at Eastern State Hospital and has accepted a position as Chief of Psychological Services at the Allentown State Hospital, Allentown, Pennsylvania. Dr. Arthur J. Bachrach has replaced Dr. Orr as Chairman of the Committee on Professional Ethics of the Psychology Section. Dr. Kenneth E. Lloyd has been added to the membership of the Committee.

At the meeting of the Blue Ridge Psychological Club in Roanoke on October 7, 1955, Dr. Thomas C. Camp of St. Albans Sanitarium, Radford, spoke on "Experiences of Psychiatric Teams in Coal Mining Communities". The next meeting of the Club was held at Western State

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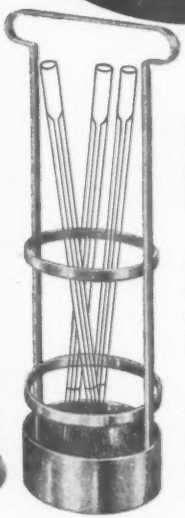

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Hospital, Staunton, on December 3. Dr. Allen Calvin of Hollins College spoke on "The Effects of Social Atmosphere and Intelligence on Problem Solving". The February meeting was held at Sweet Briar College on February 10. Dr. Frank Hardesty and Mrs. Anne Hardesty discussed some experiences with German Psychology while affiliated with Hamburg University.

Antonia Bell Morgan of Aptitude Associates was an invited speaker on two panels held at the December meeting of the A.A.A.S. in Atlanta. These panels were "Developing Leaders in Science" and "Education of the Gifted".

Dr. William J. Morgan of Aptitude Associates was a featured speaker at the first World Wide Guerrilla Warfare Conference, held at the Psychological Warfare Center, Fort Bragg, N. C. in January. Dr. Morgan's talk was entitled "Behavioral and Social Science Research on Guerrilla Warfare Since World War II". Dr. Morgan also spoke in January before the faculty and student body at Fort Holabird, the Army's intelligence school in Baltimore, on "Selection-Assessment Procedures". Dr. Morgan is the author of a book, recently published by Gollancz in England, on "Spies and Saboteurs: Selection and Training".

At the Annual Meeting of the Virginia Mental Health Association in Williamsburg on February 11, Cyril R. Mill, psychologist for the Richmond Public Schools, served as moderator for a panel dealing with "What Virginia Is Doing for the Mental Health of Children". Miss Roberta Fitzgerald, psychologist at the Educational Therapy Center, Richmond, served as a member of the panel, along with Dr. Faith Gordon, psychiatrist, Memorial Guidance Clinic, Richmond, Dr. James J. Thorpe, Director, Fairfax County Child Guidance Clinic, Falls Church, and Miss Helen Hill, visiting teacher, Richmond Public Schools.

Mrs. Ernestine Cox Peak, William and Mary '52, M.A. University of North Carolina, and Acting Instructor in Psychology at the College from February to September 1955, has taken a position in the Psychology Department at Eastern State Hospital. Mr. Eli Fleisher joined the staff at Eastern State December 1, 1955. Mr. Fleisher is a candidate for the Ph.D. at Yeshiva University. Dr. I. L. Chambers, Ph.D. University of Kentucky, and currently teaching at Muskingum College, Ohio, has been appointed as Chief Psychologist, starting July 1, 1956.

During the first week of February, Dr. Gilbert J. Rich of the Roanoke Guidance Center conducted a survey and evaluation of the Wayne County Clinic for Child Study in Detroit. This is one of the half dozen oldest psychological clinics for children still in existence and now confines its services almost exclusively to the Juvenile Court.

Frank Verdicchio, Ph.D., University of North Carolina, transferred on January 1, 1956, from Augusta Veterans Administration Hospital to the Psychology Department, McGuire Hospital, Richmond.

Dell Lebo, Richmond Professional Institute, received his Ph.D. on January 28 from Florida State University. R. Omer Lucier, Richmond Pro-

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fessional Institute, attended the Institute on General Semantics at Princeton, New Jersey, in November.

—RICHARD H. HENNEMAN, *University of Virginia*

STATISTICS SECTION

Dr. Boyd Harshbarger attended a conference of the Southern Regional Education Board to review contracts and memoranda as the Chairman of the Regional Committee on statistics. He is also on the Program Committee for the annual IMS meeting.

Dr. R. A. Bradley is organizer and a participant of a session on paired comparisons for the joint meeting of the IMS Society and Biometrics which will be held at Princeton in April. Dr. M. E. Terry, formerly of the Virginia Polytechnic Institute, will be chairman of the session. Dr. Bradley has published "Rank Analysis of Incomplete Block Designs," *Biometrika*, Volume 42, Parts 3 and 4, December, 1955. He has been elected a member of the E-11 Committee on Quality Control of Materials of the American Society for Testing Materials.

Dr. John E. Freund is the author of two papers which appeared in *Mathematical Monthly*, as well as the book, "A Modern Introduction to Mathematics," published by Prentice-Hall, Inc.

Dr. R. L. Wine is organizer of the analysis of variance session for the joint meeting of the IMS and Biometrics which will be held at Princeton in April. Professors T. S. Russell and C. Y. Kramer will take part in this session.

Professor C. Y. Kramer has published a paper entitled "On the Analysis of Variance of a Two-Way Classification with Unequal Sub-Class Numbers," *Biometrics*, Volume 11, No. 4, December, 1955.

Dr. William A. Thompson, Jr. has published two papers, "On the Ratio of Variances in the Mixed Incomplete Block Model," *The Annals of Mathematical Statistics*, Volume 26, No. 4, December, 1955, and "The Relative Size of the Inter- and Intra-Block Error in an Incomplete Block Design," *Biometrics*, Volume 11, No. 4, December, 1955.

Dr. George Edgett published "Multiple Regression with Missing Observations Among the Independent Variables," *Journal of the American Statistical Association*, Volume 51, No. 273, March, 1956. The research for this was done at the Virginia Polytechnic Institute while he was a visiting professor.

Mr. D. E. W. Schumann completed his requirements for his Ph.D. degree in statistics. His thesis title was "Comparisons of the Sensitivities of Experiments Using Different Scales of Measurement." He has returned to South Africa as Head of the Department of Statistics at the University of Stellenbosch. His address is: Department of Statistics, University of Stellenbosch, Stellenbosch, South Africa.

The Sixth Annual Conference, Textile Division, American Society for Quality Control, was held February 13-15 at the Institute of Textile Tech-

nology, with an attendance of close to 300 persons from southern and eastern U. S. and several representatives from Canada and overseas.

Norbert L. Enrick, head of the Statistics Department, Institute of Textile Technology, presented a paper on "Process to Process Variations Analysis in Textile and Chemical Manufacture" before the Delaware Section, American Society for Quality Control, January 5, 1956. He is also scheduled to present a paper on "Conventional and Newer Methods of Loom Stop Testing," before the Southern Textile Methods and Standards Association, at Clemson, S. C., Spring Meeting, March 22 and 23.

"Modern Mill Controls" has come out, reprinted in booklet form, and is available through the publisher, Modern Textile Magazine, at 303 Fifth Avenue, New York 16, N. Y. It is intended to supplement Mr. Enrick's prior series, also issued in reprint form, on "Quality Control through Statistical Methods," reviewed as a "generally excellent manual" in the A.S.A. Journal, by Professor R. J. Hader, of North Carolina State College.

—LIONEL WEISS, *University of Virginia*

Virginia Academy of Science

Program

OF THE

Thirty-Fourth Annual Meeting

AT HOTEL JEFFERSON

RICHMOND, VIRGINIA

MAY 9, 10, 11, 12, 1956

Host to Meeting

Richmond Area University Center, Inc.

Virginia Academy of Science

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W. SCHUYLER MILLER (Randolph-Macon), *Commercial Exhibits*
ROBERT F. SMART (University of Richmond), *Biology Field Trip*
R. P. HACKNEY (American Tobacco Co., Research Lab.), *Chemical Industry Tours*
WILLIAM M. MCGILL (Virginia Geological Survey), *Geology Field Trip*
ROSCOE D. HUGHES (Medical College of Virginia), *Signs, Maps, and Parking*
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HOST TO MEETING

RICHMOND AREA UNIVERSITY CENTER, INC.

General Program of The Thirty-Fourth Annual Meeting 1956

All meetings, unless otherwise indicated, will be held at the Hotel Jefferson, Richmond, Virginia

WEDNESDAY, MAY 9

5:00 P.M. to 10:00 P.M.—Registration for Junior Academy Members and Participants in the Science Talent Search. Main Lobby.

5:00 P.M. to 10:00 P.M.—Arrangement of Exhibits. Jefferson Court.

THURSDAY, MAY 10

8:00 A.M. to 10:00 P.M.—Registration. Main Lobby.

9:00 A.M.—Meeting of Science Exhibit Judges. Randolph Room. Meeting of Science Talent Search Judges. Virginia Room.

9:30 A.M.—Meeting of Chairmen, Exhibitors, and Science Talent Search Participants. Monticello Room.

10:00 A.M. to 12:30 P.M. and 1:30 to 4:00 P.M.—Finalists of Talent Search Meet with Chairmen and Interviewers. Monticello Room, Randolph Room, Virginia Room, and Library.

10:00 A.M. to 12:30 P. M. and 1:30 to 4:00 P. M.—Judging of Science Exhibit Contest. (Encouragement of Juniors at their Exhibits.) Jefferson Court.

2:00 P.M.—Meeting of the Council. Randolph Room.

4:00 P.M.—Meeting of Section Officers. Monticello Room. Meeting of Junior Academy of Science Committee. Virginia Room.

4:30 P.M.—Meeting of Section Editors. Randolph Room.

8:00 P.M.—Virginia Junior Academy of Science Assembly. National Geographic Society Lecture. John Marshall High School Auditorium, 8th and Marshall Streets.

9:15 P.M. to 9:50 P.M.—*Annual Academy Conference.* John Marshall High School Auditorium.

FRIDAY, MAY 11

8:30 A.M. to 10:00 P.M.—Registration. Main Lobby.

9:00 A.M. to 11:00 A.M.—Coffee Hour for Visiting Ladies with Hat Show by Sara Sue of Miller & Rhoads. Lobby.

9:00 A.M.—Section Meetings. See the detailed section programs for the time schedule of papers.

Agricultural Sciences—Empire Room "A".

Astronomy, Mathematics, and Physics—Flemish Room.

Bacteriology—Monticello Room.

Biology—Empire Room "B".

Chemistry—Library "A" and "B".

Education—Second Baptist Church House, 7 East Franklin Street, Room 11.

Engineering—Virginia Room.

Geology—Y. M. C. A., 2 East Franklin Street, Game Room.

Medical Sciences—Washington Room.

Psychology—Second Baptist Church House, 7 East Franklin Street, Little Theatre.

Science Teachers—Ballroom.

Statistics—Second Baptist Church House, 7 East Franklin Street, Room 10.

12:00 Noon to 1:00 P.M.—Virginia Junior Academy of Science Assembly. (See Program of Junior Academy.)

1:00 P.M. to 2:00 P.M.—Recess for Luncheon.

2:00 P.M.—Section Meetings.

3:30 P.M. to 5:00 P.M.—Reception for Visiting Ladies. Glasgow House, 1 West Main Street.

5:00 P.M. to 7:45 P.M.—Recess for Dinner.

7:45 P.M.—Virginia Academy of Science Assembly. Ballroom. Short Business Meeting. Election of Officers.

Presentation of Distinguished Service Awards.

Presentation of the J. Shelton Horsley Research Award.

Guest Speaker: Dr. Edgar Anderson, Director, Missouri Botanical Garden, St. Louis.

Subject: "How to Measure a Species Difference and Why Bother."

The general public is invited to attend.

SATURDAY, MAY 12

9:00 A.M.—Section Meetings.

9:30 A.M.—Meeting of the Advisory Panel on Education in the Sciences, Virginia Academy of Science. Ballroom. All interested in science education in Virginia are invited to attend and take part in the discussion.

10:00 A.M.—Meeting of the Council of the Academy. Randolph Room.

Program of
Virginia Junior Academy of Science

All meetings, unless otherwise indicated, will be held at the Hotel Jefferson, Richmond, Virginia.

WEDNESDAY, MAY 9

5:00 P.M. to 10:00 P.M.——Registration for Junior Academy Members and Participants in the Science Talent Search. Main Lobby.

5:00 P.M. to 10:00 P.M.——Arrangement of Exhibits. Jefferson Court.

THURSDAY, MAY 10

8:00 A.M. to 10:00 A.M.——Registration for Junior Academy Members and Guests. Main Lobby.

9:30 A.M.——Meeting of Chairmen, Exhibitors, and Science Talent Search Participants. Monticello Room.

10:00 A.M. to 12:30 P.M. and 1:30 to 4:00 P.M.——Finalists of Talent Search Meet with Chairmen and Interviewers. Monticello Room, Randolph Room, Virginia Room, and Library.

10:00 A.M. to 12:30 P.M. and 1:30 to 4:00 P.M.——Judging of Science Exhibit Contest. Jefferson Court.

12:30 P.M. to 1:30 P.M.——Recess for Luncheon.

4:00 P.M.——Meeting of Junior Academy of Science Committee. Virginia Room.

5:00 P.M. to 6:00 P.M.——Garden Party for Junior Scientists and Their Sponsors. Glasgow House, 1 West Main Street.

6:00 P.M. to 7:45 P.M.——Recess for Dinner.

8:00 P.M.——Virginia Junior Academy of Science Assembly. John Marshall High School Auditorium, 8th and Marshall Streets.

National Geographic Society Lecture

Guest Speaker: Mr. Newman Bumstead, Assistant Chief of the National Geographic Society Cartographic Staff.

Subject: ATLANTIC'S FARTHEREST SHORES. The lecture will be illustrated with motion pictures in color. Members of the Senior Academy, local members of the National Geographic Society and the general public are invited to attend.

FRIDAY, MAY 11

9:30 A.M.——Tours for those not attending Section Meetings of the Senior Academy. Several Juniors are scheduled to present papers at these Sectional Meetings.

12:00 Noon to 1:00 P.M.—Virginia Junior Academy of Science Assembly. Awards will be presented and officers elected. Seniors interested are invited to attend. Ballroom.

Section of Agricultural Science

R. W. ENGEL, *Chairman*
P. M. REAVES, *Vice-Chairman*
J. W. MIDYETTE, JR., *Secretary*
C. W. ALLEN, *Section Editor* (1956)

FRIDAY, MAY 11, 1956—9:00 A.M.—EMPIRE ROOM A.

JEFFERSON HOTEL

9:00 Announcements, Committee Appointments, etc.

1. 9:10 Moisture Release in Field Cured Peanuts on Heating.
D. L. Hallock; *Virginia Agricultural Experiment Station.*

2. 9:20 A Cover Crop Study in Southeastern Virginia.
D. L. Hallock; *Virginia Agricultural Experiment Station,*
A. H. Allison; *Smith-Douglas Fertilizer Company.*

3. 9:30 Effect of Lime on Rock Phosphate Availability.
W. W. Moschler; *Virginia Agricultural Experiment Station.*

4. 9:45 A Practical Field Determination for Nitrogen Content of Anhydrous Ammonia Fertilizer.
M. B. Rowe; *Virginia Department of Agriculture.*

5. 10:20 Recruitment of Personnel for the Agricultural Sciences.
Edwin Cox; *Virginia-Carolina Chemical Company.*

10:35 Recess

6. 10:45 Possible Effects of O.A.S.I. on Agricultural Resource Use and Research Needed.
W. L. Gibson, Jr.; *Virginia Agricultural Experiment Station.*

7. 11:00 Competitive Relationships Between Corn and Soybeans for Use of Land in Virginia.
Carl W. Allen; *Virginia Agricultural Experiment Station.*

8. 11:15 Efficiency Study of Pipeline and Conventional Milking Systems.
P. M. Reaves and W. E. Blalock; *Virginia Agricultural Experiment Station.*

9. 11:30 A Comparative Case Study of Two Systems of Dairy Barn Operations.

R. Lee Chambliss, Jr.; *Virginia Agricultural Experiment Station.*

10. 11:45 Physical Characteristics of Slaughter Animals at Southern Auction Markets.
Roy G. Stout; *Virginia Agricultural Experiment Station.*

12:00 Adjourn for Lunch

FRIDAY, MAY 11—1:00 P.M.

1:00 Announcements

11. 1:10 GUEST SPEAKER:
Atomic Energy and Agriculture.
W. Ralph Singleton; *Director, Blandy Experimental Farm.*

12. 2:00 Breeding Frost Hardy Peaches for Virginia.
C. D. Oberle; *Virginia Agricultural Experiment Station.*

13. 2:15 The Effect of Molasses Supplementation on the Digestibility and Consumption of Pasture Herbage by Grazing Animals.
W. A. Hardison; *Virginia Agricultural Experiment Station,*
J. T. Reid; *Cornell University Agricultural Experiment Station.*

14. 2:30 Chemical Characters of Fibers from Sheep and Goats.
Lubow A. Margolena; *U. S. Department of Agriculture.*

2:45 Recess

15. 2:50 Effects of Hexachloronapthalene on Vitamin A. Metabolism in the Rat.
G. Edwin Bunce; *Virginia Polytechnic Institute.*

16. 3:05 Bean Seed Treatment Trials in Eastern Virginia.
T. J. Nugent and R. N. Hofmaster; *Virginia Truck Experiment Station.*

17. 3:20 Some Influences of Soil Moisture, Date of Sampling, Fertilizer and Cropping on Certain Soil Tests, with a Sassafras Sandy Loam Soil.
E. M. Dunton, Jr.; *Virginia Truck Experiment Station.*

18. 3:15 Use of Soil Survey Information in Fairfax County, Virginia.
E. F. Henry; *Virginia Agricultural Experiment Station.*

19. 3:50 Review of Plant Parasitic Nematodes Found in Virginia During 1955.
A. M. Somerville, Jr.; *Virginia-Carolina Chemical Co.*

4:05 Business Session.

Section of
Astronomy, Mathematics, and Physics

J. GORDON STIPE, JR., *Chairman*
MELVIN A. PITTMAN, *Secretary*
F. L. HEREFORD, *Section Editor* (1956)

FRIDAY, MAY 11, 1956—9:00 A.M.—FLEMISH ROOM

1. 9:00 Permeability Tensors for the Propagation of TE and TB Modes in Round Wave Guides.
   Edward F. Turner, Jr.; *The George Washington University.*
2. 9:10 Birefringent Properties of Ferrite Rods in Circular Wave Guides.
   Nicholas Karayianis; *Diamond Ordnance Fuze Laboratory.*
3. 9:20 Scattering of Polarized Neutrons (Theoretical).
   Frank L. Hereford; *University of Virginia.*
4. 9:35 Scattering of Polarized Neutrons (Experimental).
   Billy McCormac, Malcolm F. Steuer, Clarence D. Bond, Frank L. Hereford; *University of Virginia.*
5. 9:45 Production and Scattering of Polarized Electrons.
   William G. Pettus; *University of Virginia.*
6. 10:00 Sunlight Integrator of Wide Intensity Range.
   E. W. Glossbrenner and H. Y. Loh; *Virginia Polytechnic Institute.*
7. 10:10 Ion Source for 2 MEV Electrostatic Accelerator.
   J. T. Rogers; *Virginia Polytechnic Institute.*
8. 10:25 Design and Construction of a Magnetic Analyzer for the V. P. I. Electrostatic Accelerator.
   David W. Oliver; *Virginia Polytechnic Institute.*
9. 10:40 Voltage Control of the V. P. I. Electrostatic Accelerator.
   George L. Ball; *Virginia Polytechnic Institute.*
10. 10:55 Some Remarks on the Diagonalization of Matrices in Quantum Mechanics.
    S. Olanoff; *Virginia Polytechnic Institute.*
11. 11:05 The Distribution of Ionization Energy Losses of μ Mesons in Argon.
    T. E. Gilmer, Jr., Robert Mace, E. D. Palmatier; *Experiment Incorporated and the University of North Carolina.*

12. 11:15 The Preparation and Strange Behavior of Pseudomonocrystals of Alpha-Titanium.
Francis J. Denise and Henry Liedheiser, Jr.; *Virginia Institute for Scientific Research.*

13. 11:25 Time of Flight Apparatus for High Energy Neutrons.
Philip J. Dolan, Herbert A. Fincher, Patrick J. Kenny; *University of Virginia.*

14. 11:40 Business Meeting.

12:00 Presentation of Awards to Junior Academy Members—Ballroom.

1:00 Recess for Lunch.

FRIDAY, MAY 11, 1956—1:45 P.M.

15. 1:45 Elastic Scattering of 14 MEV Neutrons.
Patrick J. Kenny, Herbert A. Fincher, Philip J. Dolan; *University of Virginia.*

16. 2:00 Positron Annihilation in Liquids and Solids.
S. Berko; *University of Virginia.*

17. 2:15 Temperature and Phase Effects in Position Annihilation.
Hugh S. Landes and Artley J. Zuchelli; *University of Virginia.*

18. 2:30 Concerning the Liquefaction of Helium.
L. G. Hoxton; *University of Virginia.*

19. 2:45 Temperature Effect in G-M Counters.
Addison D. Campbell; *University of Richmond,* (work done at University of North Carolina).

20. 3:00 Instrumentation Problems in Underwater Explosion Tests.
M. E. Cruser, Jr.; *U.E.R.D. Norfolk Naval Shipyard.*

21. 3:15 Tensile Strength of Liquid Helium.
J. W. Beams; *University of Virginia.*

22. 3:30 Mechanical Strength of Thin Films of Silver.
M. M. Jones, Jr., S. Martinez, A. L. Stamper; *University of Virginia.*

23. 3:45 Magnetic Suspension Microbalance.
C. W. Hulburt and M. G. Sheffield; *University of Virginia.*

24. 4:00 Tensile Strength of Thin Films of Metal at Liquid Nitrogen Temperature.
P. B. Price, Jr.; *University of Virginia.*

25. 4:15 The Compression of Condensed Gases to 20,000 Kg/cm^2 at Low Temperature (Experimental).
John W. Stewart; *University of Virginia.*

26. 4:30 Determination of the Molecular Weight of Raffinose and Viomycin by the Equilibrium Ultracentrifuge Method.
Kenneth D. Williams; *University of Virginia.*

27. 4:45 Some Methods of Making Thin Film Windows for Electrons.
Kent Ford, Jr.; *University of Virginia.*

SATURDAY, MAY 12, 1956—9:00 A.M.

1. 9:00 An Interesting R-L-C Circuit Used as a Test Problem.
Addison D. Campbell; *University of Richmond.*

2. 9:10 Particle Distribution from a Thin Source in Contact with a Collimator.
Glenn H. Miller; *Ordnance Research Laboratory, University of Virginia.*

3. 9:20 Statistical Relationship Between Galactic Orbital Elements of Red Dwarf Stars.
E. R. Dyer, Jr.; *Leander McCormick Observatory, University of Virginia.*

4. 9:30 A Pressure Regulator for a Low-Pressure Continuous Flow Ionization Chamber.
Ralph A. Lowry, John E. Osher, Glenn H. Miller; *Ordnance Research Laboratory, University of Virginia.*

5. 9:40 Defining Functions by Series.
Robert C. Yates; *College of William and Mary.*

6. 9:55 Astrometric Investigation of a Star Association in the Constellation of Cygnus.
Heinrich K. Eichhorn; *Leander McCormick Observatory, University of Virginia.* (Introduced by A. N. Vyssotsky.)

7. 10:05 Spectral Classification of Stars in the AGK^2 Zones.
A. G. A. Balz, Jr.; *Leander McCormick Observatory.*) *University of Virginia.* (Introduced by A. N. Vyssotsky.)

8. 10:20 Astrometric Orbit of *X* Draconis.
H. L. Alden and V. Osvalds; *University of Virginia.*

9. 10:30 The Ladder Problem.
John N. Packard; *Randolph-Macon College.*

10. 10:40 Certain Properties of Hyper-cubes, Regular Hyper-tetrahedrons and Hyper-spheres.
Herta T. Freitag and Arthur H. Freitag; *Hollins College and Jefferson High School.*

11. 10:55 A Simplified Design for a Sphere Grinder Applicable to Very Hard Materials.
Lilly L. Rappaport and William H. Dancy, Jr.; *Ordnance Research Laboratory, University of Virginia.*

12. 11:05 The Effect of Film Thicknes on the Adhesion of Chromium Films Electrodeposited on Steel.
William H. Dancy, Jr., and William M. Bland; *Ordnance Research Laboratory, University of Virginia.*

13. 11:15 Taylor Instabilities in High Speed Slip Flow.
Robert B. Nelson and A. R. Kuhlthau; *Ordnance Research Laboratory, University of Virginia.*

14. 11:25 An Improved Method for the Accurate Determination of the Surface Temperature of Rapidly Moving Bodies.
A. R. Kuhlthau and Lilly L. Rappaport; *Ordnance Research Laboratory, University of Virginia.*

15. 11:40 A High Speed Electronic Analog Multiplier.
Donald F. Nieman; *Ordnance Research Laboratory, University of Virginia.*

Section of Bacteriology

A. L. ROSENSWEIG, *Chairman*
BARBARA H. CAMINITA, *Secretary*
P. ARNE HANSEN, *Section Editor* (1956)

FRIDAY, MAY 11, 1956—10:30 A.M.—MONTICELLO ROOM

10:30 Business Meeting.
12:00 Presentation of Awards to Junior Academy Members—Ballroom.
1:00 Recess for Lunch.

FRIDAY, MAY 11, 1956—1:30 P.M.

1. 1:30 Lactose Urea Iron Agar; A New Differential Tube Medium for Isolation of *Salmonella.*
John McNeill Sieburth; *Agricultural Experiment Station,* Blacksburg.

2. 1:50 A New Serological Technique: Freeze-Agglutination. 1. Application to Chronic Respiratory Disease of Chickens.
C. H. Domermuth and E. P. Johnson (with technical assistance of A. P. Tichelaar MT/ASCP); *Agricultural Experiment Station,* Blacksburg.

3. 2:10 Experimental Encephalomyelitis in Cats.
P. Y. Paterson, E. D. Brand, and M. I. Hansrote; *University of Virginia School of Medicine.*

4. 2:40 An Unusual Colonial Formation by a Strain of *Pseudomonas Rubinosa.*
H. J. Welshimer; *Medical College of Virginia.*

5. 3:00 Antigenic Components of *Lactobacillus lactis.*
Robert H. Miller and P. Arne Hansen; *University of Maryland,* College Park.

6. 3:20 Form Variation and Electrophoresis.
Shelley Harrell and P. Arne Hansen; *University of Maryland,* College Park.

Section of Biology

J. L. McHUGH, *Chairman*
J. N. DENT, *Secretary*
ROBERT T. BRUMFIELD, *Section Editor* (1957)

FRIDAY, MAY 11, 1956—9:00 A.M.—EMPIRE ROOM "B"

1. 9:00 Live Trapping as a Technique for Evaluating Rabbit Population Phenomena.
John B. Redd, Jr.; *Virginia Polytechnic Institute.*

2. 9:15 Possible Factors in the Decline of the Bear Kill in Virginia.
Allen Stickley; *Virginia Polytechnic Institute.*

3. 9:30 A Study of Sportsmen's Magazine Preference as a Guide to Effective Conservation Education.
Robert H. Giles, *Virginia Polytechnic Institute.*

4. 9:45 Natural History of the Dismal Swamp.
Roger H. Rageot; *Norfolk Museum.*

5. 10:00 INVITATIONAL PAPER. Recent Developments in the Study of Marine Productivity.
Dayton E. Carritt; *Chesapeake Bay Institute,* Annapolis, Maryland.

6. 10:30 Some Patterns in Parasitism.
William J. Hargis, Jr.; *Virginia Fisheries Laboratory.*

7. 10:45 The Acanthocephala of Mountain Lake Mammals.
Harry L. Holloway; *Roanoke College.*

8. 11:00 Three Modes of Reproduction within a Single Genus (*Histiostoma,* Anoetidae, Acarina).
Roscoe D. Hughes and Caroline Goode Jackson; *Medical College of Virginia.*

9. 11:15 Taxonomic and Morphological Studies on the Genus *Acanthatrium* (Trematoda: Lecithodendriidae).
Thomas C. Cheng; *University of Virginia.*

10. 11:30 A New Species of *Aphanomyces*, and Its Significance in the Taxonomy of the Water-molds.
William W. Scott; *Virginia Polytechnic Institute.*

11. 11:45 The Chromosome Morphology and Evolution of Some Species in the Genus *Aglaonema.*
Gertrude Earl; *The Blandy Experimental Farm.*

12. 12:00 Monograph of the Genus *Rosa* in North America. I. *Rosa acicularis* Lindl.
Walter H. Lewis; *The Blandy Experimental Farm.*

13. 12:15 Morphological Variation within a Clarke County Population of *Ipomoea hederacea* (L.) Jacquin.
Robert J. Knight; *The Blandy Experimental Farm.*

14. 12:30 Hemophilia in the Human Female—A Review and Evaluation.
M. C. Shawver; *Madison College.*

12:45 SECTIONAL BUSINESS MEETING.

FRIDAY, MAY 11—2:00 P.M.

15. 2:00 The Effects of Nucleic Acids on Growth of Timothy Roots.
Robert T. Brumfield; *Longwood College.*

16. 2:15 Plants as Indicators.
A. B. Massey; *Virginia Polytechnic Institute.*

17. 2:30 Intraspecific Adaptation to Varying Photoperiod in Certain Members of the Convolvulaceae.
Robert J. Knight; *The Blandy Experimental Farm.*

18. 2:45 Electrophoretical and Spectrophotometrical Investigations of a Germination Inhibiting Substance in the Seedcoats of *Datura.*
J. E. Irvine and J. J. Rappaport; *University of Virginia.*

19. 3:00 The Modification of Cell Size in Timothy Roots by Alpha Particles.
Donald E. Foard; *Longwood College.*

20. 3:15 INVITATIONAL PAPER. Radioisotopes in Biological Research.
T. R. Rice; *U. S. Shellfish Laboratory*, Beaufort, N. C.

3:45 SYMPOSIUM. Why Are We Failing to Attract Students to Enter Professional Biology?
Carl G. Baker; *National Cancer Institute*, Bethesda, Md.
W. Ralph Singleton; *University of Virginia.*
Robert F. Smart; *University of Richmond.*

SATURDAY, MAY 12—9:30 A.M.—EMPIRE ROOM "B"

21. 9:30 The Effect of Partial Hepatectomy on the Hematology and Spleen Size of the Golden Hamster.
W. L. Mengegier; *Madison College.*

22. 9:45 Cytochemical Observations on the Differentiation of the Anterior Pituitary Gland of the Rat.
Jean C. Dofflemoyer; *University of Virginia.*

23. 10:00 Conjoined Twinning in Crayfish.
Elizabeth M. Zipf; *University of Virginia.*

24. 10:15 The Crayfishes of the Lower Flint-Chattahoochee River System.
C. W. Hart and Horton H. Hobbs, Jr.; *Randolph-Macon College* and *University of Virginia.*

25. 10:30 The Agar Diffusion Technique as Applied to the Study of the Serological Relationships of Crayfishes.
Rose Mary Johnson; *University of Virginia.*

26. 10:45 Reactions of *Stenostomum virginianum* to Vital Staining.
E. W. Pullen; *University of Virginia.*

27. 11:00 Studies of the Gastrotricha with Especial Reference to *Polymerurus rhomboides* Stokes in Virginia.
C. E. Packard; *Randolph-Macon College.*

28. 11:15 A Clarification of the Species of the Genus *Typhloplana.*
John G. Mahan; *Lynchburg College.*

29. 11:30 Some Morphological Studies on Resistant and Non-resistant Strains of the German Cockroach.
John G. Mahan; *Lynchburg College.*

Section of Chemistry

RICHARD M. IRBY, JR., *Chairman*
MARY E. KAPP, *Secretary*
CARL J. LIKES, *Section Editor* (1957)
Notice Concurrent Sessions Friday Morning

FRIDAY, MAY 11, 1956—9:00 A.M.—LIBRARY "A"

1. 9:00 The Fluorination of Cyanogen Bromide.
H. Lee Craig, Jr. and Eugene R. Nixon; *Reynolds Metals Company and University of Pennsylvania.*

2. 9:15 Derivatives of Chelidamic Acid.
D. G. Markees and G. W. Kidder; *Amherst College,* Amherst, Mass.

3. 9:25 New Aminopyridines and Related Compounds.
D. G. Markees and G. W. Kidder; *Amherst College,* Amherst, Mass.

4. 9:35 New Analogs of Guanine and Xanthine.
D. G. Markees and G. W. Kidder; *Amherst College*, Amherst, Mass.

5. 9:45 The Rates of the Acid-Catalyzed Reactions of Aromatic Aldehydes with *n*-Butylamine.
George M. Santerre and Thomas I. Crowell; *Cobb Chemical Laboratory, University of Virginia.*

6. 10:05 Reactions of Nitryl Chloride.
W. D. Goode, Jr., R. D. Whitaker, and John H. Wise; *Washington and Lee University.*

7. 10:15 Nuclear Substituted Analogs of 3,4-Dihydroxyphenylalanine.
Carl Kaiser and Alfred Burger; *Cobb Chemical Laboratory, University of Virginia.*

8. 10:30 Synthesis of Purine and Ribofuranosylphosphonic Acids and Related Compounds.
Manfred E. Wolff and Alfred Burger; *Cobb Chemical Laboratory, University of Virginia.*

9. 10:45 The Preparation of Chloro Substituted N, N Diphenyl Benzamides.
James E. Worsham, Jr. and James W. Cook; *University of Richmond.*

10. 10:55 A Kinetic Study of the B-Glucosidase-B-D-Glucoside System.
Helen L. Whidden; *Randolph-Macon Woman's College.*

11. 11:10 Stereochemistry and Conformations in Conjugated Unsaturated Ketones and Enols. Addition-enolization.
Robert E. Lutz and Chi-Kang Dien; *Cobb Chemical Laboratory, University of Virginia.*

12. 11:25 Unsaturated Cyclic Sulfones: Pyrolysis of 3-Bromoethyl-2, 5-dihydrothiophene 1, 1-Dioxide.
Robert C. Krug and Teh Fu Yen; *Virginia Polytechnic Institute.*

13. 11:40 Some Experiments Regarding the Elbs Reaction.
Frank A. Vingiello and Walter W. Zajac, Jr.; *Virginia Polytechnic Institute.*

14. 11:55 The Apparent Role of Cystine in Various Commercial Proteins.
William R. Smithey, Jr.; *Virginia-Carolina Chemical Corporation.*

15. 12:05 The Bohr Theory of Atomic Hydrogen.
Eric Adelberger; *Washington-Lee High School*, Arlington.

12:20 **Business Meeting—Library "A"**

FRIDAY, MAY 11, 1956—9:00 A.M.—WEST PARLOR

1. 9:00 Growth of Copper Powder in the Reaction of Hydrogen and Oxygen on a Copper Single Crystal.
   Robert E. Cunningham; *Cobb Chemical Laboratory, University of Virginia.*

2. 9:15 The Etching of Copper Single Crystals in Aqueous Solutions.
   G. Tyler Miller, Jr.; *Cobb Chemical Laboratory, University of Virginia.*

3. 9:30 The Development of Etch Pits, Spirals, and Facets by Heating Copper Crystals to High Temperatures in High Vacuum.
   F. W. Young; *Cobb Chemical Laboratory, University of Virginia.*

4. 9:50 A High Voltage Electron Diffraction Apparatus and Its Application to the Study of Metal Surfaces.
   Kenneth R. Lawless; *Cobb Chemical Laboratory, University of Virginia.*

5. 10:05 The Oxidation of Single Crystals of Nickel.
   Kenneth R. Lawless, Fred W. Young, and Allan T. Gwathmey; *Cobb Chemical Laboratory, University of Virginia.*

6. 10:20 Radioactive Tracers in Elucidating Antioxidant and Corrosion Inhibiting Mechanisms.
   Donald R. Campbell and James W. Cole, Jr.; *Cobb Chemical Laboratory, University of Virginia.*

7. 10:35. The Preparation of Elemental Boron of High Purity.
   Claude P. Talley, James C. Rahman, and Lloyd E. Line, Jr.; *Experiment Incorporated.*

8. 10:50 Absorption of Undiluted Vapors by Drops.
   William E. Rice; *Experiment Incorporated.*

9. 11:05 Spark Ignition of Dust Clouds.
   Lloyd E. Line, Jr. and James C. Rahman; *Experiment Incorporated.*

10. 11:20 Formation of Ions in Flames.
    H. F. Calcote and I. R. King; *Experiment Incorporated.*

11. 11:30 Semiquantitative Analysis of Alkyl Polyphosphate Mixtures.
    Thomas M. Melton; *Virginia-Carolina Chemical Corporation.*

12. 11:45 Vapor Phase Chromatography.
    R. B. Seligman, F. E. Resnik, A. E. O'Keefe, J. C. Holmes, F. A. Morrell, and D. P. Murrill; *Philip Morris and Company.*

13. 12:00 The Mass Spectrometer as a Qualitative Tool.
F. E. Resnik and J. C. Holmes; *Philip Morris and Company.*

12:20 Business Meeting—Library "A".

FRIDAY, MAY 11, 1956—2:00 P.M.—PARLOR "A"

1. 2:00 The Electrodeposition of Aluminum from Ether-amine-aluminum Chloride Solutions.
N. F. Murphy and A. C. Doumas; *Virginia Polytechnic Institute.*

2. 2:15 Gas Phase of Cigarette Smoke: The Effect of Changes in Smoking Technique on the CO_2:CO Concentration Ratio.
J. Scott Osborne, Jr. and Edward S. Harlow; *Research Laboratory, American Tobacco Company.*

3. 2:30 Acid and Base Catalysis in the Solvolysis of Alkyl Borates.
Gilbert T. Perkins and Thomas I. Crowell; *Cobb Chemical Laboratory, University of Virginia.*

4. 2:45 Oxidation of Boron.
Ira A. Updike and Grover L. Farrar; *Randolph-Macon College.*

5. 3:00 A Spectrophotometric Method for the Determination of Nickel in Human Blood.
Maxwell L. Cluett and John H. Yoe; *Pratt Trace Analysis Laboratory, University of Virginia.*

6. 3:15 Determination of Boron in Plant Tissue with a New Group of Colorimetric Reagents.
Everett C. Coghill and John H. Yoe; *Pratt Trace Analysis Laboratory, University of Virginia.*

7. 3:30 A New Class of Organic Reagents for the Spectrophotometric Determination of Trace Amounts of Osmium.
Edgar L. Steele and John H. Yoe; *Pratt Trace Analysis Laboratory, University of Virginia.*

8. 3:45 A Study of the Boron-Curcumin System.
W. A. Powell and Emmett Poindexter; *University of Richmond.*

9. 4:00 Progress Report on Studies of Coordination of the Cations of the First Transition Series by Several Polyhydroxylamine Hydrochlorides.
W. P. Moore and Wm. E. Trout, Jr.; *University of Richmond.*

10. 4:15 The Determination of Formic Acid and Other Volatile Acids.
B. R. Warner, R. D. Carpenter and L. Z. Raptes; *Philip Morris and Company.*

Section of Education

DEFOREST L. STRUNK, II, *Chairman*
W. DONALD CLAGUE, *Secretary*
JAMES B. PATTON, *Section Editor* (1957)

FRIDAY, MAY 11, 1956—9:00 A.M.—ROOM 11,
SECOND BAPTIST CHURCH HOUSE, 7 EAST FRANKLIN STREET

1. 9:00 A Summer Reading Center for Elementary Pupils.
   Charles Turner; *Assistant Director of Research, Richmond Public Schools.*
2. 9:20 A Report of the Virginia Resource-Use Education Council.
   John H. Gwathmey; *Gun and Rod Education, Richmond Times-Dispatch.*
3. 9:40 Qualities of Experience Desirable for Prospective Teachers.
   J. P. Wynne; *Longwood College.*
4. 10:25 Experimental Study in the Teaching of Arithmetic.
   Evan G. Pattishall, Jr.; *University of Virginia.*
5. 10:50 Enriching the School Program through Audio-Visual Aids.
   Edwin M. Logan; *University of Virginia.*
6. 11:10 Predicting College Success.
   Marshall Brice; *Staunton Military Academy.*
7. 11:35 Sharing in Elementary School: Importance for Elementary Science Courses.
   Irving L. Ramsey; *University of Virginia.*

11:55 Business Meeting and Election of Officers.

12:00 Presentation of Awards to Junior Academy Members—Ballroom, Hotel Jefferson.

1:00 Recess for Lunch.

FRIDAY, MAY 11—2:00 P.M.—BALLROOM, HOTEL JEFFERSON

2:00 Symposium on the Shortage of Science Teachers.
Jointly sponsored by the Section of Science Teachers, the Manpower Committee of the Virginia Section of the American Chemical Society, and the Advisory Panel on Education in Sciences of the Virginia Academy of Science.

(*See program of Section of Science Teachers for details*).

Section of Engineering

NELSON F. MURPHY AD ROBERT W. TRUITT, *Co-Chairmen*

DAVID M. CRIM, *Secretary*

ROBERT M. HUBBARD, *Section Editor* (1958)

FRIDAY, MAY 11, 1956——9:30 A.M.——VIRGINIA ROOM

1. 9:30 A Note on the Slope of the Lift Curve in Two-Dimensional Transonic Flow.
   Robert W. Truitt; *Virginia Polytechnic Institute.*
2. 9:35 Investigation of Base Pressures on Bodies of Revolution in the Transonic Range.
   Gerald D. Walberg, Arthur C. Bruce and Robert W. Truitt; *Virginia Polytechnic Institute.*
3. 9:55 Some Aspects of Two-Dimensional Subsonic Flow.
   Reece Folb and Robert W. Truitt; *Virginia Polytechnic Institute.*
4. 10:10 A Note on the Limitation of Three-Dimensional Linear Theory for Compressible Flow.
   James B. Eades, Jr.; *Virginia Polytechnic Institute.*
5. 10:30 A Note on the Hypersonic Flow about Two-Dimensional Blunt Bodies.
   Robert W. Truitt; *Virginia Polytechnic Institute.*
6. 10:45 An Investigation of the Dynamic Response of a Two-Dimensional Thin Airfoil in Longitudinal Motion.
   Frank B. Anthony and James B. Eades, Jr.; *Virginia Polytechnic Institute.*
7. 11:05 Some Considerations of Pressure-Drag over the Front Surface of Two-Dimensional Wedges Having Different After-body Configurations.
   William P. Harrison, Jr. and Robert W. Truitt; *Virginia Polytechnic Institute.*
8. 11:25 Results of an Approximate Method for Determining Transonic Pressure-Drag over the Front Surfaces of Two-Dimensional Wedges Having Different After-Body Configurations.
   George E. Powell and Robert W. Truitt; *Virginia Polytechnic Institute.*

12:00 Noon——Presentation of Engineering Award at the meeting of the Junior Academy of Science——Ballroom.

FRIDAY, MAY 11—2:00 P.M.

9. 2:00 Operational Analogs as Dynamic Engineering Models.
O. L. Updike, Jr.; *University of Virginia.*

10. 2:25 Synopsis of Highway Sign Brightness in Relation to Position, Distance and Reflectorization.
Arthur L. Straub and Terrence M. Allen; *Virginia Council of Highway Investigation and Research.*

11. 2:45 Equilibrium Data for Viscous Ternary Liquid Systems.
John C. Howard; *University of Virginia.*

12. 3:05 Heat Transfer in Narrow Enclosed Gas Spaces.
John R. Marshall; *University of Virginia.*

13. 3:25 The Effect of Superimposed Alternating Current and Periodic Reverse Current on the Yield of Electrochemical Reactions.
Nelson F. Murphy and B. C. Doumas; *Virginia Polytechnic Institute.*

14. 3:40 Barium Titanate Probe for the Measurement of Ultrasonic Intensity.
Frank C. Vilbrandt and Narendra N. Bakhshi; *Virginia Polytechnic Institute.*

4:00 Engineering Exhibits—Presentation by members of the Junior Academy of Science.

5:00 Business Meeting and Election of Officers.

Section of Geology

TROY J. LASWELL, *Acting Chairman*
ROBERT S. YOUNG, *Secretary*
WALLACE D. LOWRY, *Section Editor* (1958)

FRIDAY, MAY 11, 1956—9:10 A.M.—Y.M.C.A.—2 EAST FRANKLIN STREET, GAME ROOM

(*Time for discussion will be allowed at end of each paper.*)

9:10 Introductory Remarks by the Chairman.

1. 9:15 Status of Topographic Mapping in Virginia.
William M. McGill; *Virginia Division of Geology.*

2. 9:32 Cleavage in the Arvonia Slate, Buckingham County, Virginia.
Jonathan Edwards, Jr.; *Virginia Polytechnic Institute.*

3. 9:44 Distribution of Triassic Fish in the Piedmont of Virginia.
Shelton P. Applegate; *University of Virginia.*

4. 9:56 Lignite in Colluvium, Smyth County, Virginia.
Charles E. Sears, Jr.; *Virginia Polytechnic Institute.*

5. 10:13 Domestic Manganese Developments.
Charles W. Massie, Sr.; *Virginia Department of Conservation and Development.*

6. 10:25 Heavy Minerals of the Patuxent Formation in Virginia.
W. M. Greene, C. L. Sherman, and D. C. Ward; *Washington and Lee University.* (Presented by D. C. Ward).

7. 10:37 Heavy Minerals in the Sands of the South River, Augusta County, Virginia.
Dorothy Carroll; *U. S. Geological Survey.*

8. 10:54 Mineralogy of Sediments from the Virginia Triassic.
Bruce W. Nelson; *Virginia Polytechnic Institute.*

9. 11:11 Erosion by Catastrophic Floods in the Ridge and Valley Province.
John T. Hack; *U. S. Geological Survey.*

11:30 Announcements.

12:00 Noon Presentation of Awards to Junior Academy Members ——Ballroom.

1:00 Recess for Lunch.

FRIDAY, MAY 11, 1956——2:00 P.M.——Y.M.C.A., 2 EAST FRANKLIN STREET, GAME ROOM

10. 2:00 Crystallization of Carbonate Material as a Top and Bottom Indicator.
C. R. B. Hobbs, Jr.; *Virginia Polytechnic Institute.*

11. 2:12 Granites and Phyllites of Southeastern Piedmont Virginia and Their Relation to the Tectonic Maps of the Area.
A. A. Pegau and W. B. Brent; *Virginia Division of Geology and Oklahoma A. and M.* (Presented by A. A. Pegau).

12. 2:24 Feeder Dikes of the Catoctin Greenstone in Albemarle County Virginia.
Tinsley Mack; *University of Virginia.*

13. 2:36 Heavy Minerals of Coastal Sands South of Virginia Beach, Virginia.
J. R. Alford, J. K. Kane, and D. M. Marthinson; *Washington and Lee University.* (Presented by J. R. Alford).

14. 2:48 Chert-Dolomite Relationships in the Knox Dolomite.
R. V. Dietrich and W. D. Lowry; *Virginia Polytechnic Institute.* (Presented by R. V. Dietrich).

15. 3:05 The Correlation of Piedmont Virginia Strata and an Interpretation of Piedmont Structure Based on This Correlation.
Wilbur A. Nelson; *University of Virginia.*

16. 3:22 A Diabase Dike near Afton, Virginia.
H. Robert Hopkins; *University of Virginia.*

17. 3:34 Cirque-like Depression near Big Meadows, Virginia.
Richard G. Roane; *University of Virginia.*

18. 3:46 Wind Transport of Sand: A Physical-Mathematical Approach.
Edwin F. Ford; *Wakefield High School, Arlington, Virginia.*

4:15 Outline of Field Trip.
Wayne E. Moore; *Virginia Polytechnic Institute.*

4:30 Business Meeting.

SATURDAY, MAY 12, 1956—8:00 A.M.

8:00 Field Trip: The Pleistocene Stratigraphy of the Virginia Coastal Plain.
Leader: Wayne E. Moore.
Place of assembly and details of trip to be announced during Friday meeting.

Section of Medical Sciences

GROVER C. PITTS, *Chairman*
GERALDINE M. DUNCAN, *Secretary*
CHALMERS L. GEMMILL, *Section Editor* (1958)

FRIDAY, MAY 11, 1956—9:00 A.M.—WASHINGTON ROOM

1. 9:00 An Evaluation of the Metachromasy of Anionic Dyes.
John W. Kelly; *Medical College of Virginia.*

2. 9:15 Some Problems and Techniques in Biological C^{14} Measurement.
William A. Peabody; *Medical College of Virginia.*

3. 9:30 Lipid and Pigment Inclusions in the Motor Cortex of Aging Brains.
Robert H. Brownson, *Medical College of Virginia.*

4. 9:45 The Effect of Acylation on the Biological Activity of Hydrazine Compounds.
Herbert McKennis, Jr. and Jesse H. Weatherby; *Medical College of Virginia.*

5. 10:00 Vasomotor Changes Produced by Chronic Stimulation of the Cerebral Cortical Pressor Areas.
E. C. Hoff, and J. F. Kell, Jr.; *Medical College of Virginia.*

6. 10:15 Integration of Blood Pressure Responses in Decerebration.
Thomas R. Harwood, J. F. Kell, and E. C. Hoff; *Medical College of Virginia.*

7. 10:30 Studies on Some Physiologic and Clinical Conditions Associated with Increased Fibrinolytic Activity of the Blood.
Susan J. Mellette and Louis A. Leone; *Medical College of Virginia.*

8. 10:45 Perthane (Q-137) Administration to the C3H Mouse and Its Effect on the C3H/BA Mammary Carcinoma.
Louis A. Leone, Henry Hahn, and Susan J. Mellette; *Medical College of Virginia.*

9. 11:00 The Inhibition of Azo-Dye Carcinogenesis by Varying Dietary Levels of Certain Benzimidazoles.
C. C. Clayton and L. D. Abbott, Jr.; *Medical College of Virginia.*

10. 11:15 Effects of Physical Exercise on Gross Body Composition of the Guinea Pig.
Grover C. Pitts; *University of Virginia School of Medicine.*

11. 11:30 Histochemical Studies on the Effects of Castration and Androgen Replacement on Rat Epididymides.
L. F. Cavazos; *Medical College of Virginia.*

12. 11:45 The Effect of Thermal Injury on the Metabolic Activity of the Brain, the Pituitary, the Adrenal and the Pineal Gland of the Rat, Measured by P^{32} Uptake.
O. J. Malm and O. E. Skaug; *Medical College of Virginia.*

12:00 Business Meeting.

FRIDAY, MAY 11—2:00 P.M.

13. 1:45 Alterations in Casein by Exposure to Ethylene Oxide.
Herbert G. Windmueller, Clemens J. Ackerman, and R. W. Engel; *Virginia Agricultural Experiment Station.*

14. 2:00 The Effect of Nucleosides on Phosphate Transfer in Human Erythrocyte Ghosts.
D. R. H. Gourley; *University of Virginia School of Medicine.*

15. 2:15 Phosphate Uptake in the Erythrocytes of Human Blood Heated *in Vitro.*
Ralph A. Natvig and Odvar Skaug; *Medical College of Virginia.*

16. 2:30 The Transfer of Energy from p-Terphenyl to Riboflavin.
Chalmers L. Gemmill; *University of Virginia School of Medicine.*

17. 2:45 Ryanodine Induced Contractures in Frog Skeletal Muscle.
Mary Frances Arrighi and Robert W. Ramsey; *Medical College of Virginia.*

18. 3:00 Psyche and the Human Uterus.
William Bickers; *Richmond.*

19. 3:15 Toxicity Studies on Salicylamide in Man.
Reno Porter and Allan L. Forbes; *Medical College of Virginia.*

20. 3:30 The Significance of the Serological Reactions in Rheumatoid Arthritis.
John Vaughan and Marion Waller; *Medical College of Virginia.*

21. 3:45 Plastic Prosthetics in the Post-Surgical Care of Diabetic Gangrene. A Preliminary Report.
Albert Pincus, Milton Cummins, Ted Levy, William Bricker, Jr., and Stanley Bricker; *Richmond.*

22. 4:00 Lipid Concentration of Human Adrenals with Particular Reference to Hypertensive Disease.
Cornelia Hoch-Ligeti, Karen Irvine, and James Irvine; *University of Virginia School of Medicine.*

23. 4:15 Rental Function in Man and Dogs Rendered Polycythemic by Low Oxygen Tension.
E. Lovell Becker; *Medical College of Virginia.*

24. 4:30 The Pelger-Hüet Anomaly in a Negro Family.
Jonas C. Strouth and Roscoe D. Hughes; *Medical College of Virginia.*

25. 4:45 Schultze's Picture in the Bovine Colon.
James R. Rooney, II; *Virginia Agricultural Experiment Station.*

Section of Psychology

GILBERT J. RICH, *Chairman*
AUDREY M. SHUEY, *Secretary-Treasurer*
RICHARD H. HENNEMAN, *Section Editor* (1959)

FRIDAY, MAY 11, 1956—2:00 P.M.—LITTLE THEATRE, SECOND BAPTIST CHURCH HOUSE, 7 EAST FRANKLIN STREET

2:00 Introductory Remarks by the Chairman.

1. 2:10 The Effect of Certain Sensory Stimulation on the Perception of a Long Time Interval.
Patricia A. Rund; *Falls Church.*

2. 2:30 Skin Temperature Effects on Vibratory Thresholds.
Glenn R. Hawkes; *University of Virginia.*

3. 2:50 An Experimental Study of Vibrotactile Apparent Motion.
William H. Sumby; *University of Virginia.*

4. 3:10 Training on a Vibratory Communication System.
William C. Howell; *University of Virginia.*

5. 3:30 A Comparative Personality Study of a Group of Stutterers and Hard of Hearing Patients.
Reuben S. Horlick; *Walter Reed Army Medical Center.*

6. 3:50 Language Behavior in the Mentally Retarded.
Henry Winthrop; *Hollins College.*

7. 4:10 Critical Factors in the Academic Acceleration of Gifted Children: Hypotheses Based on Clinical Data.
Antonia Bell Morgan; *Aptitude Associates, Inc.*

FRIDAY, MAY 11—6:30 P.M.

6:30 Annual Dinner. (Place to be announced)

7:30 Business Meeting.

SATURDAY, MAY 12—9:30 A.M.—LITTLE THEATRE, SECOND BAPTIST CHURCH HOUSE, 7 EAST FRANKLIN STREET

8. 9:30 The Rat's Adjustment to Twenty-three-Hour Food-Deprivation Cycles.
Marvin H. Weasner; *University of Virginia.*

9. 9:50 Factors Influencing Complex Task Performance.
Milton H. Hodge; *University of Virginia.*

10. 10:10 Reinforcement and Complex Verbal Behavior.
William E. Montague; *University of Virginia.*

11. 10:30 Conditons Determining the Efficiency of Multiple Task Performance.
John B. Feallock; *University of Virginia.*

12. 10:50 Academic Success of Public and Private School Students in College: I. The Freshman Year.
Audrey M. Shuey; *Randolph-Macon Woman's College.*

13. 11:10 An Investigation of Several Methods of Teaching Contour Interpretation.
F. J. McGuigan; *Hollins College.*

SATURDAY, MAY 12—2:00 P.M.—LITTLE THEATRE, SECOND BAPTIST CHURCH HOUSE, 7 EAST FRANKLIN STREET

2:00 Symposium: The Psychologist's Role in Community Mental Health.
MODERATOR: John A. Blake; *Central State Hospital.*

Section of Science Teachers

FRANKLIN D. KIZER, *Chairman*
SAMUELLA CRIMM, *Chairman-Elect*
MARTHA W. DUKE, *Secretary*
CAROLINE GAMBRILL, *Section Editor* (1959)

FRIDAY, MAY 11, 1956—8:30 A.M.—BALLROOM

THEME: *WHAT'S NEW IN BIOLOGY?*

1. Business Meeting.
2. Recent Trends in Plant Science Work at the Blandy Experimental Farm.
   Walter S. Flory, Jr.; *Blandy Experimental Farm, University of Virginia.*
3. Recent Trends in Medical Genetics.
   Roscoe D. Hughes; *Medical College of Virginia.*
4. A Study of the Firefly and the Chemical Nature of Its Bioluminescence.
   Leland N. Edmunds, Jr.; *Newport News High School.* (Winner of the 15th Annual Science Talent Search.)
5. Laboratory Tours: Department of Agriculture, Rodney C. Berry, *State Chemist.*
   10:30-12:00 Noon—Division of Animal and Dairy Industries. Dr. Bendix.
   12:00 Noon Presentation of Awards to Junior Academy Members—Ballroom.
   1:00 Recess for Lunch.

FRIDAY, MAY 11—2:00 P.M.

7. SYMPOSIUM ON THE SHORTAGE OF SCIENCE TEACHERS.
   Jointly sponsored by the Section of Science Teachers, the Manpower Committee of the Virginia Section of the American Chemical Society, and the Advisory Panel on Education in Sciences of the Virginia Academy of Science.

The widespread concern over the shortage of qualified teachers of the sciences and mathematics prompted the sponsoring groups to bring together distinguished speakers to present National, State, University, and Community viewpoints. The causes of the apparent shortage and some of the problems encountered by the organizations in their endeavors to help meet the shortages will be outlined. The discussions will be focused

on what the sponsoring groups can do to assist in the maintenance of adequate number of qualified teachers.

MODERATOR:

James W. Cole, Jr.; *Department of Chemistry, University of Virginia.*

SPEAKERS:

Dael Wolfle; *Executive Officer, American Association for the Advancement of Science.*

Dowell J. Howard; *Superintendent of Public Instruction, State Board of Education, Commonwealth of Virginia.*

William L. Duren, Jr.; *Dean of the College of Arts and Sciences, University of Virginia.*

John S. Coleman; *Executive Secretary, Division of Natural Sciences, National Research Council, National Academy of Sciences.*

DISCUSSION STARTERS:

Eugene D. Crittenden; *Director of Research, Nitrogen Division, Allied Chemical and Dye Corporation, Hopewell.*

Edward S. Harlow; *Assistant Laboratory Manager, American Tobacco Company Research Laboratory.*

Mrs. B. G. Heatwole; *Chairman, Virginia Junior Academy of Science Committee.*

Franklin D. Kizer; *Supervisor of Science, Norfolk County Schools.*

Fred R. Millhiser; *Laboratory Director for Orlon Research, Benger Laboratory, E. I. duPont de Nemours and Co., Waynesboro.*

Sidney S. Negus; *Chairman, Department of Biochemistry, Medical College of Virginia.*

Louis A. Pardue; *Vice-President, Virginia Polytechnic Institute.*

Russell J. Rowlett; *Assistant Director of Research, Virginia-Carolina Chemical Corporation.*

Section of Statistics

M. C. K. TWEEDIE, *Chairman*
JOHN E. FREUND, *Vice-Chairman*
C. Y. KRAMER, *Secretary*
LIONEL WEISS, *Section Editor* (1959)

FRIDAY, MAY 11, 1956—9:00 A.M.—ROOM 10, SECOND BAPTIST CHURCH HOUSE, 7 EAST FRANKLIN STREET

1. 9:00 Introductory Remarks by the Chairman.
2. 9:05 The Comparison of Sensitivities of Similar Experiments.
   D. E. W. Schumann and R. A. Bradley; *Virginia Polytechnic Institute.*
3. 9:30 Variance Components for a Two-Way Classification with Proportional Frequencies.
   R. E. Walpole; *Virginia Polytechnic Institute.*
4. 9:55 Linear Programming.
   R. J. Freund; *Virginia Polytechnic Institute.*

10:20 Intermission.

5. 10:30 Uses of Electronic Computing Systems.
   Daniel Teichroew; *National Cash Register Company.*
6. 11:30 Business Meeting.

12:00 Presentation of Awards to Junior Academy Members — Ballroom, Hotel Jefferson.

1:00 Recess for Lunch.

FRIDAY, MAY 11—2:00 P.M.

7. 2:00 Economic Problems Are Subject to Statistical Analysis.
   D. P. Morton; *Virginia Polytechnic Institute.*
8. 2:25 Use of Principal Components in Economic Problems.
   E. N. Fiske; *Virginia Polytechnic Institute.*
9. 2:50 Some Distribution Theory Connected with Gaussian Processes.
   I. Miller and J. E. Freund; *Virginia Polytechnic Institute.*

3:00 Intermission.

10. 3:25 The Distribution of Column Totals in Sociometric Matrices.
    Paul Minton; *Virginia Polytechnic Institute.*
11. 3:50 Comparison of Technicians' Subjective Ratings.
    T. S. Russell and R. A. Bradley; *Virginia Polytechnic Institute.*

SATURDAY, MAY 12, 1956—9:00 A.M.—ROOM 10, SECOND BAPTIST CHURCH HOUSE, 7 EAST FRANKLIN STREET

12. 9:00 Restricted Occupancy Theory.
J. E. Freund; *Virginia Polytechnic Institute.*

13. 9:25 The Correlation between Variate Values and Normal Scores for Ranks.
R. A. Bradley and H. A. Still; *Virginia Polytechnic Institue.*

14. 9:50 Control of Paint Consumption in a Mechanized Process by Quality Control.
John Sykes; *Marshall Manufacturing Corporation.*

15. 10:15 Variations Flow Analysis—A New Statistical Tool for Industrial Process Control.
N. L. Enrick; *Institute of Textile Technology.*

10:40 Intermission.

16. 10:50 Statistical Properties of Inverse Gaussian Distributions.
M. C. K. Tweedie; *Virginia Polytechnic Institute.*

17. 11:15 The Power of Multiple Range Tests.
R. L. Wine; *Virginia Polytechnic Institute.*

18. 11:40 Factorials in Incomplete Block Designs.
C. Y. Kramer and R. A. Bradley; *Virginia Polytechnic Institute.*